The Electrical Industry's Weekly Magazine January 2, 1961

Electrical World

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A McGraw-Hill Publication

Teletype and EDP Speed Accounting, Data for Control

. . . page 34

SUPPLY LINES this week:

Capacitor Prices Dip . . .
Purchasing Appraised . . .
Manufacturers' Outlook . . .

UNIV MICROFILMS INC
EDITORIAL DEPT
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here it is! A REAL
ONE-HAND TOOL

installs
INSULINK® and LINKIT®
one crimp per end!

You'll like this ONE-HAND TOOL ... from start to finish, you can really work it with only ONE HAND. You can close it with less than a 50 lbs. squeeze; it weighs only 2½ lbs. and is only 12" long. You couldn't ask for an easier service tool ... it's the only *real* ONE-HAND TOOL.

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Insert stripped wire ends into INSULINK; caps grip and hold conductors.

Get up close to your work. Position ONE-HAND TOOL on INSULINK only once per crimp.

A series of easy strokes comple the crimp. Dies produce oxid removing wiping action betwe conductor strands.

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Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

JANUARY 2, 1961

Vol. 155, No. 1

Electrical What in the World . . .

At this point we are coming through what seems to be the most pleasant and at the same time the most confusing time of the year. The *Electrical World* office is probably not much different than your own in this respect.

It is a time of slightly dazed expressions, late commuter trains, last-minute gift buying, and the occasional bit of a Christmas carol whistled or hummed. It is also time for closing out expense accounts, looking back at the year ending, and trying to look with sound understanding at the year ahead. (Did you see last week's *Electrical World?*)

For us, and probably for you, too, this is the season that is shot through with excitement. As we think about it, the excitement seems to come from a prevailing atmosphere of change—of new things about to happen. A new administration is taking over in Washington. Electric utility plans for the new year are firmed up. Our own travel schedules and major assignments are planned. These things and many others contribute to the feeling of anticipation and its related excitement.

In a few weeks the annual outbreak of spring conventions and conferences will occur. The editors will start living out of suitcases again, and readjusting work habits to airplanes and hotel rooms. The anticipation carries over to this part of our lives, too, as we look forward to seeing new faces and places, and hearing and reporting on new ideas and concepts for the electrical industry.

So, we'll probably be seeing you soon. And if we do not, or if we should fail to mention it when we do—here's our sincere hope for a happy, prosperous and progressive New Year.

Chuck Hochgesang

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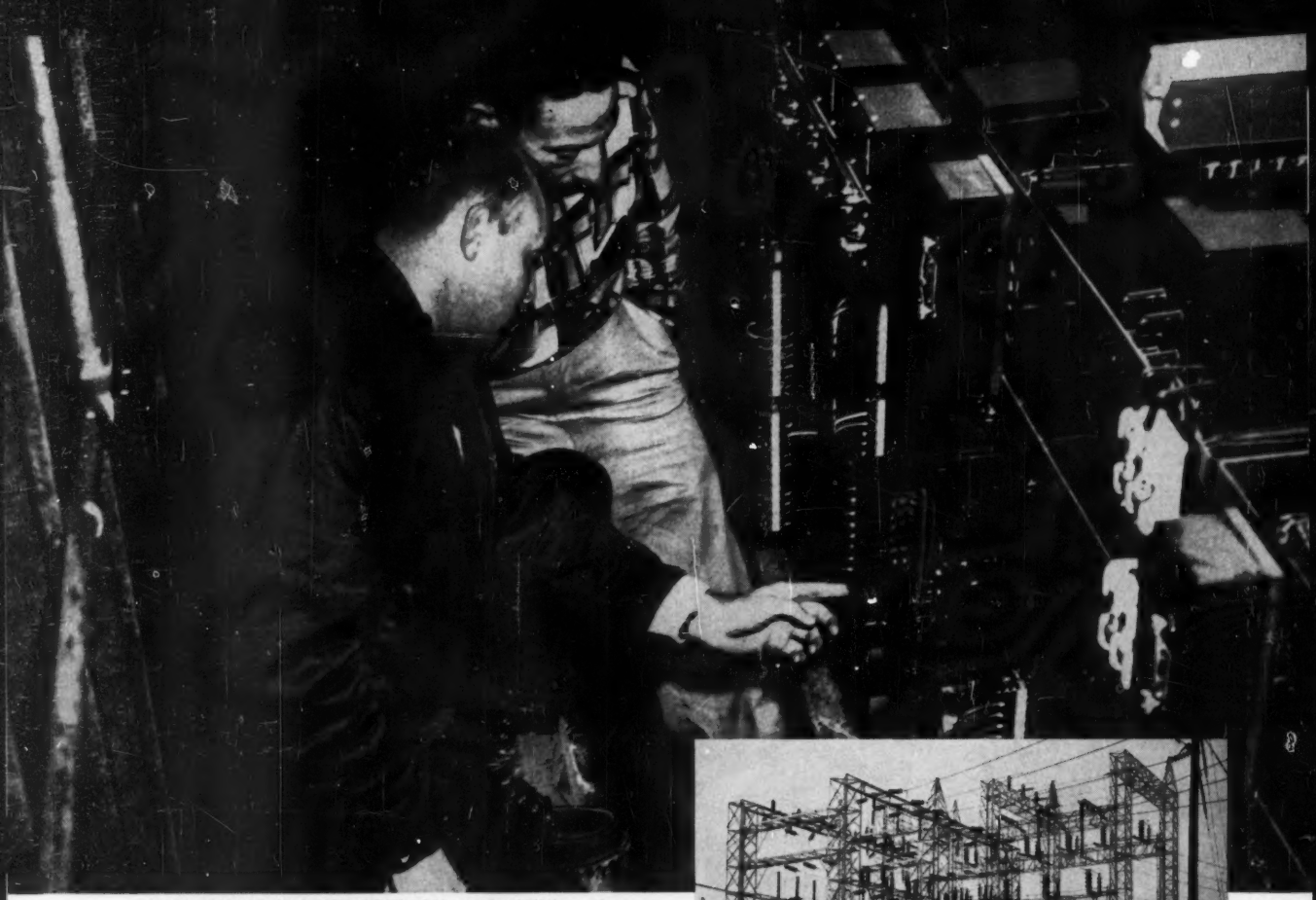
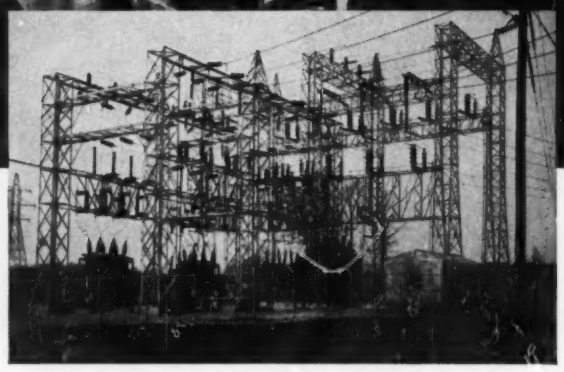


CARL SHOLAR AND KEN WEST of Kentucky Utilities, who supervised installation of all cables at the new Walker Substation, examine terminations of some of the Okonite control cable in the station. In the foreground, Mr. Sholar points to Okolite-Okoprene aerial cable which goes to the Earlington Substation.



Kentucky Utilities chooses Okonite control cable on basis of performance record

Kentucky Utilities chose Okonite control cable for its new 161 to 69 kv substation one-half mile west of Earlington, Kentucky, and used it in many ways . . . underground in ducts, in conduit and aerially on a messenger.

Okonite's service record in other Kentucky Utilities installations was the prime factor in specification of the control cable for Walker Substation. Time after time, in recent years, the utility has purchased Okonite control cable because of satisfaction with its performance.

Another important factor to Kentucky Utilities was that Okonite manufactured the cable with colored neoprene on each conductor for easy coding. (Included in the installation at Walker are Okolite-Okoprene aerial control cables, Watertite-Okoprene control cables and Okoseal 200 PVC insulated switchboard cable.)

Okonite Cable'bility* can help *you,* too, in meeting the exact requirements of your job, from manufacture through installation. To help you specify the best cable for your important power and control needs, contact your Okonite representative or write for Bulletin EW-1117, "How To Choose Insulated Cable." The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J. 8140

*OKONITE Cable'bility . . . cable craftsmanship since 1878

***where there's electrical power . . . there's* OKONITE CABLE**

Letters

Standards Do Not Hinder Progress

To the Editor:

My congratulations to Assistant Editor John Damon for his Second Street Lighting Survey (EW, Nov. 14, p 69). It presents in interesting and easily digested form many of the important trends and desires of utilities.

The desire for standardization of glassware and luminaires was clearly expressed but that old "bugaboo" was still there: "No standardization which would stand in the way of progress." This incorrect concept of modern standardization has been allowed to stand in the way of progress through standards too long. We should refute it whenever it arises.

Modern concepts of standards never stand in the way of progress. They provide interchangeability so that the latest, the best, the lowest cost units can be substituted for the old, the broken, the obsolete. They encourage experimentation through high salvage with standard parts. They encourage competition to improve the product or lower the cost. They do not stop any one from moving toward a better and different goal.

If or when standards do not keep pace with the trends, few public utilities let them stand in their way. They move even if this means a departure from the standard. This is what happened in the field of mercury vapor and fluorescent street lighting. It is going to take a real effort to establish standards for horizontal burning mercury luminaires and optical assemblies; but we should not fear that such standards will stand in the way of progress.

The only thing that will stand in the way of progress is an unwillingness to accept new ideas. This unwillingness to accept new ideas occurs more frequently where there are local customs than where there are national standards.

Arthur T. Green
Chairman, EEI Representatives
EEI-NEMA Joint Committee on Standardization
of Street Lighting Equipment
Electric Building
Buffalo 3, N. Y.

This is your column in Electrical World. Correspondence should be addressed to Letters Editor, Electrical World, 330 W 42nd St, New York 36, N. Y.

Dateline . . .

OLYMPIA, WASH.—Although public power forces have won the first two rounds in a battle for control of the 1961 Washington state legislature, friends of invester-owned power still have hopes for favorable legislation in the session convening in January.

Public power won its first victory by a margin of only a few votes when pro-public-power John L. O'Brien was renominated in a Democratic caucus for an unprecedented fourth term as speaker of the House of Representatives. O'Brien foes have indicated they may make another move to defeat O'Brien when the House organizes formally, if they find O'Brien's committee appointments unfair.

Invester-owned power lost again when the Legislative Council, a 21-man bipartisan group which functions between sessions, rejected an "equalization" tax on electric utilities. The tax proposal was designed to cancel the present property tax on all electric utilities. It probably will be submitted to the 1961 legislature but, without Council approval, its chances of passing are regarded as slim.

Strongest opposition to public power in the 1961 legislature is expected to come from the "We Want to Vote on PUD Committee," which recently thwarted plans of the Thurston County PUD to condemn properties of the Puget Sound Power & Light Co. This committee is sponsoring four bills which would:

1. Require a PUD to submit condemnation proposals, together with financing plans, to the voters;

2. Provide for dissolution of a PUD;

3. Grant the power of initiative and referendum to residents and voters of PUDs on major policy decisions of PUD commissions; and

4. Require a vote on any PUD tax levy where the money is to be used for feasibility study on acquiring utility property.

The four proposed bills already have been at-

(*Continued on page* 28)

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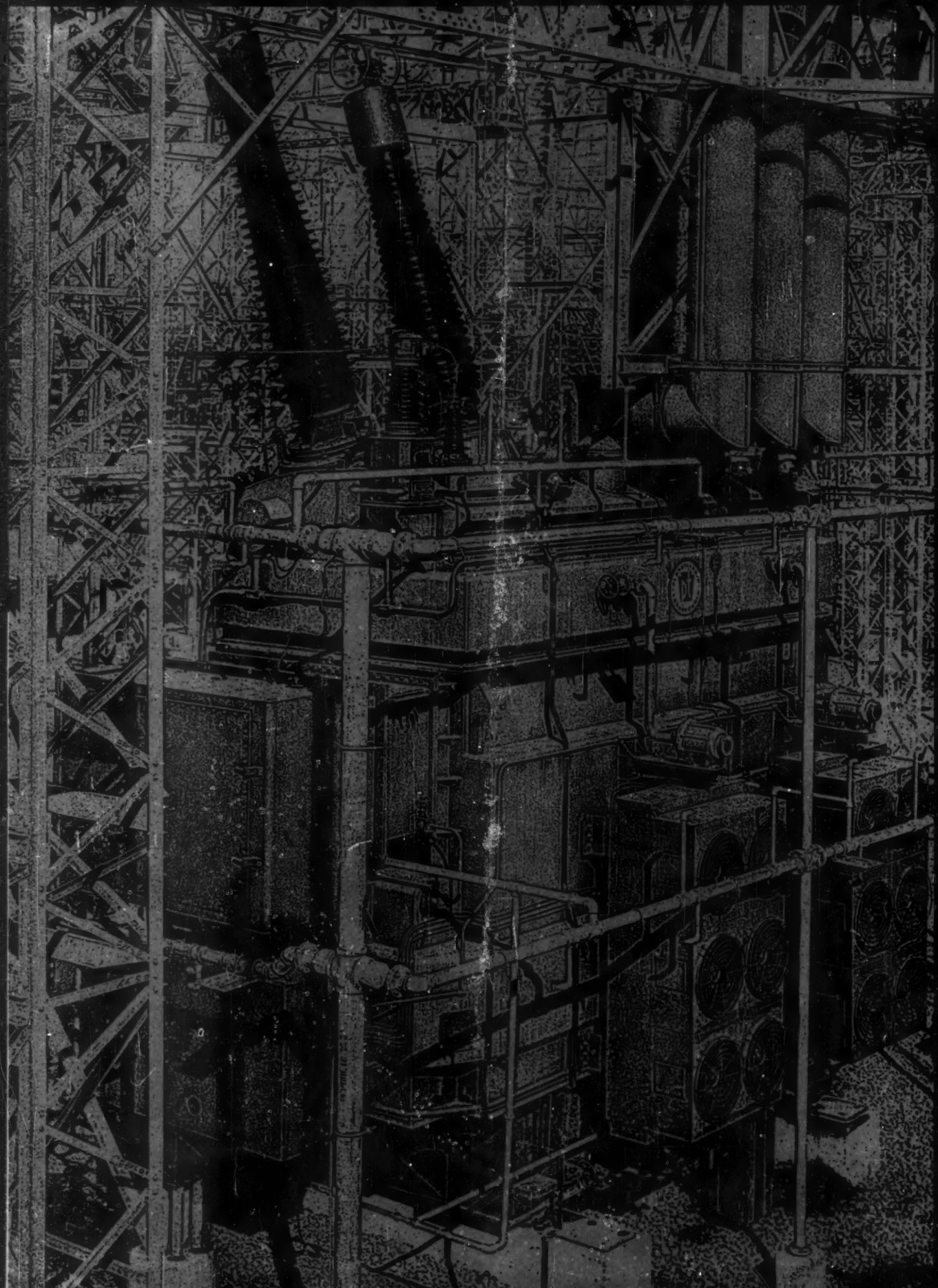


Pennsylvania EHV transformers serve atomic energy plant

Among the relatively few extra-high-voltage (EHV) units in the country, two Pennsylvania 100,000-kva, 330-kv transformers are used to supply part of the voltage-regulated power for the 14.4-kv distribution system of the Atomic Energy Commission's Portsmouth, Ohio, plant.

Primary windings of these EHV, 330-kv transformers are designed to be corona-free and to have uniform impulse-voltage distribution. Pennsylvania's Contour Design shell-form construction is fundamentally applicable in meeting these and other EHV design requirements. In addition, it provides space-saving and weight-saving compactness.

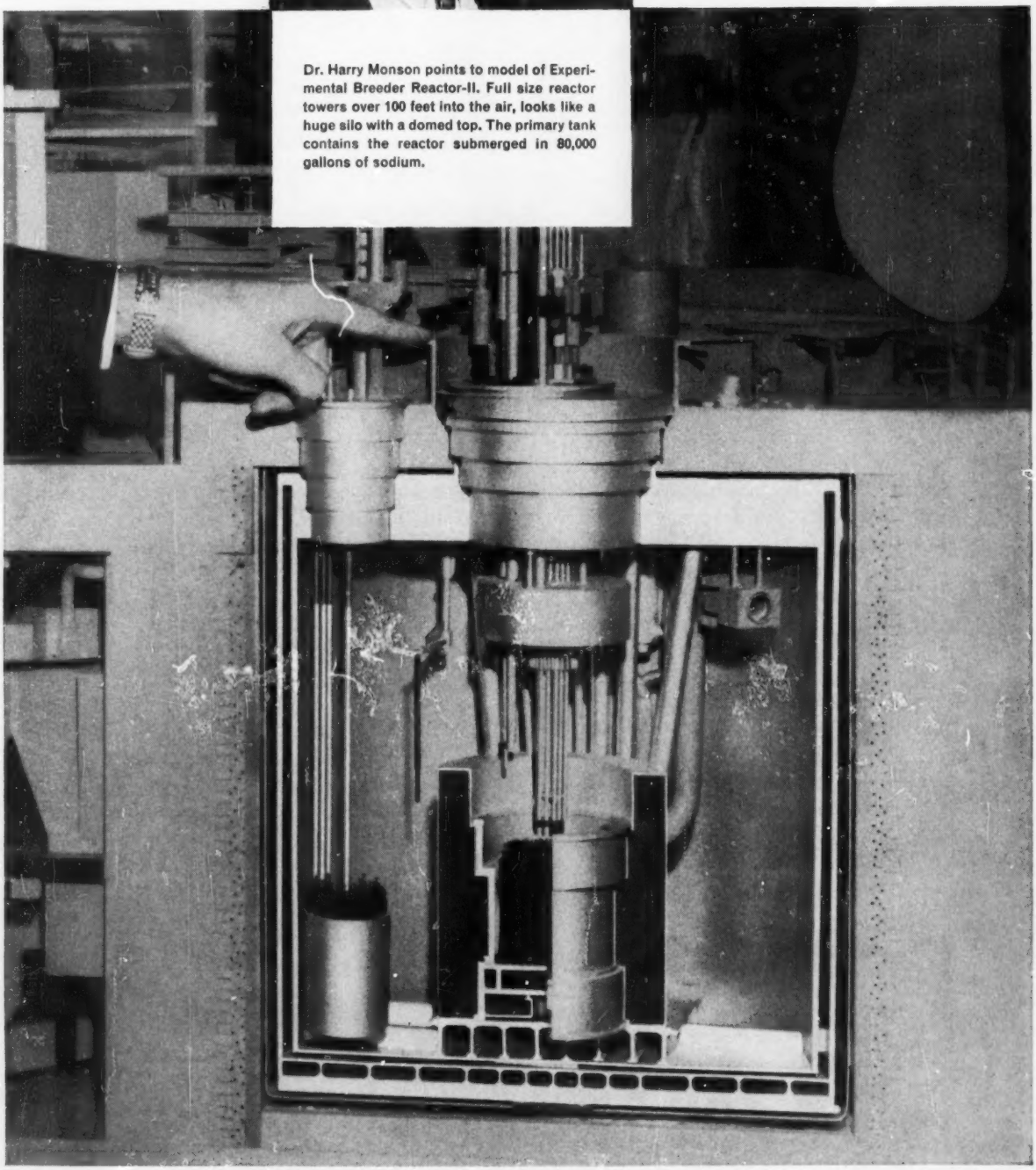
For design and construction details of Pennsylvania's Contour Design Shell-form Transformers, basically suited for your highest-voltage and highest-capacity installations, request Catalog No. P-560. Write on your company letterhead to Power Transformer Sales Department, Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

PENNSYLVANIA POWER TRANSFORMERS

Left: One of two 100,000-kva, Class FOA, 330,000GrdY-volt Pennsylvania Contour Design Shell-form Transformers supplying voltage-regulated power to the 14.4△ kv distribution system of the Atomic Energy Commission's Portsmouth, Ohio, plant. The rugged, quiet, load tap changing equipment provides plus and minus 10% regulation in 32 steps of ⅝%.

This mark tells you
a product is made of
modern, dependable Steel.

Support structure



Dr. Harry Monson points to model of Experimental Breeder Reactor-II. Full size reactor towers over 100 feet into the air, looks like a huge silo with a domed top. The primary tank contains the reactor submerged in 80,000 gallons of sodium.

for atomic reactor designed with USS "T-1" Steel

A new Experimental Breeder Reactor (EBR-II) is under construction at the National Reactor Station near Idaho Falls, Idaho. This $29,000,000 project deals with the peacetime applications of atomic energy and may well show the way to an economical source of power.

This is the first nuclear reactor to have a completely integrated fuel processing plant. It will be a "closed cycle" power plant, where nuclear fuel will be employed to produce heat and at the same time "breed" additional fuel. The new fuel can then be processed into new fuel elements right in the EBR-II facility.

The longer you run, the more fuel you have. It's like putting 10 gallons of gas in your auto tank, then after driving many miles, to discover you have 14 or 15 gallons. That's how Dr. Harry O. Monson describes it. He is Project Engineer at the Argonne National Laboratory in Argonne, Illinois, where plans for construction of EBR-II were originally made.

Why USS "T-1" Steel was used.

Dr. Monson says, "It takes a strong, tough steel to support a 1,000-ton tank filled with 80,000 gallons of sodium—and "T-1" Steel is the best material we could find for columns, supporting beams and the central ring of this reactor vessel."

The bottom closure of the vessel is a solid reinforced concrete structure within which are embedded six channel beams tying together peripherally the lower ends of the columns. The top closure is tied to the bottom closure by six columns, 36" wide, located about its periphery. These columns, as well as all the beams of the top and bottom closures, are fabricated of USS "T-1" Steel.

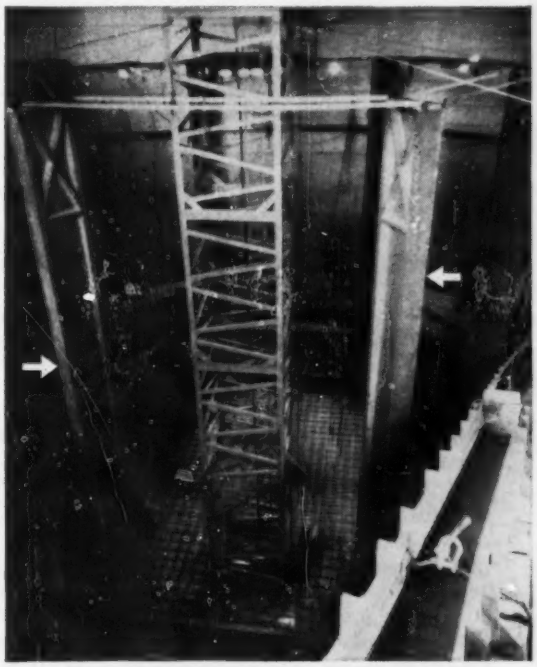
In addition to supporting the main structure, the "T-1" Steel also plays an important role in the reactor's primary containment system which is capable of withstanding, without breaching, an explosion equivalent to the detonation of 300 pounds of TNT. Such an explosion is judged to be the most serious consequence of unlikely events which might conceivably lead to an energy release in the nuclear core. To resist such an explosion, USS "T-1" Steel provides a high minimum yield strength of 100,000 psi. Yield strength of this magnitude provides a very substantial factor of safety.

Other uses for USS "T-1" Steel in construction.

The great strength of "T-1" Steel combined with weldability and high resistance to impact makes it widely used for heavy construction machinery, bridges, penstocks, pressure vessels, oil tanks and other structures where strength with least weight is desired. For complete information, write for our "T-1" Steel booklet. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

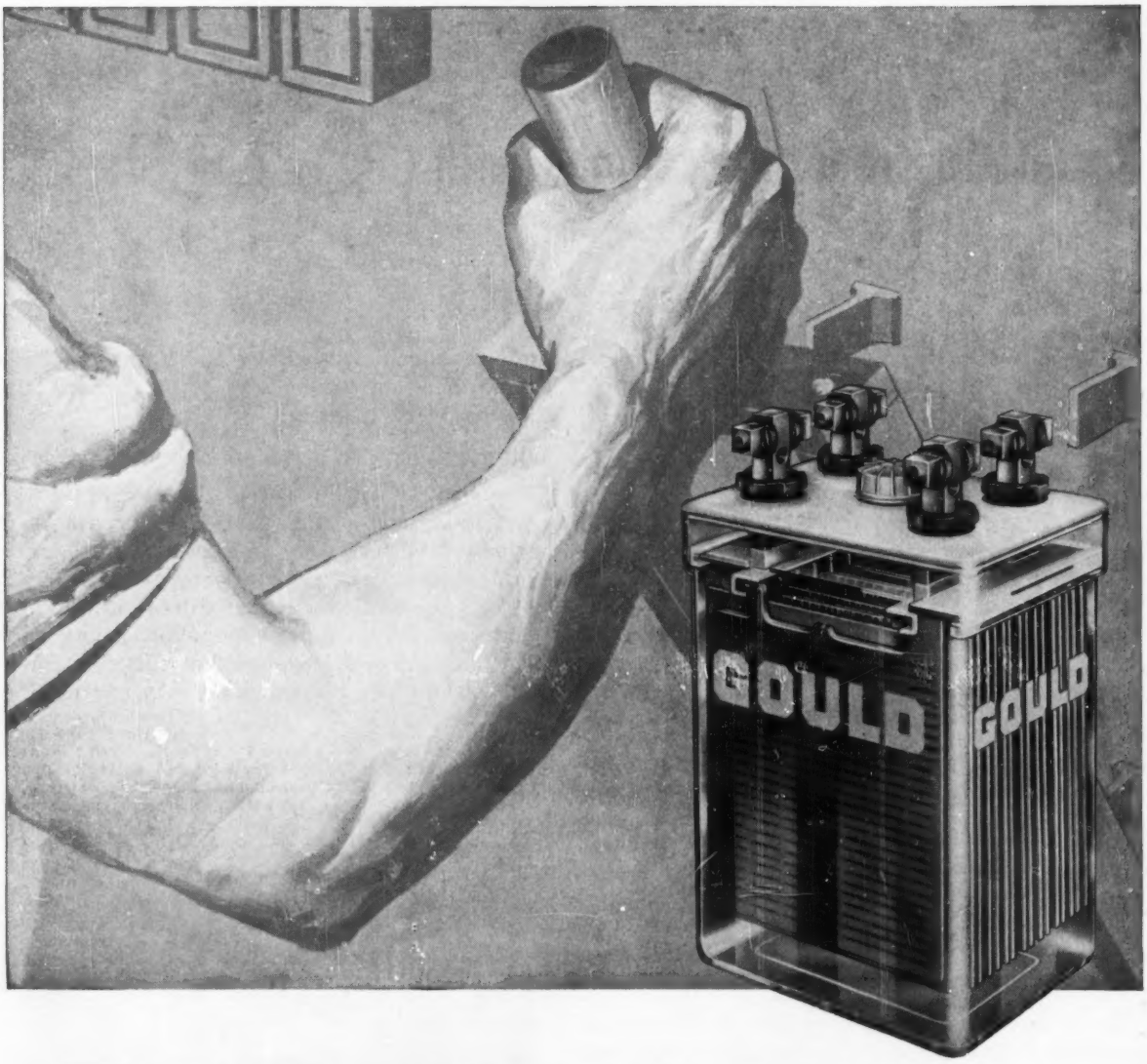
USS and "T-1" are registered trademark

Reactor under construction showing two of the six 36-inch columns welded from USS "T-1" Steel plates ranging from 1 inch to 5¼ inches thick. 184 tons of "T-1" Steel were used in the structure for columns, channels, cylinders and rings. Fabricated by Nordberg Manufacturing Co., Milwaukee, Wisconsin.



United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
National Tube—Pittsburgh
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel



Big power when you need it...

GOULD Stationary Batteries

In emergencies—when quick, reliable current is needed for longer than a moment—new Gould Stationary Batteries in Plastrite Jars offer long, trouble-free service either full float or cycle operation.

Dependable power through proper design. New Silicone O-Ring post seal expands under compression, prevents escape of electrolyte. New stronger posts assure full current-carrying capacity with maximum voltage. Improved element suspension eliminates cover breakage due to weight of battery element.

Greater Power per square inch. Gould's new Stationary Batteries in Plastrite Jars save you 30-40% more floor space; this means you can increase your battery room capacity without increasing the room size. Lightweight Plastrite Jars have great impact resistance, are unharmed by normal handling and shipment.

Gould Stationary Batteries in Plastrite Jars are available in Planté, Calcium, or Kathanode. Write for details today, or call your local Gould office listed under "Batteries—Industrial" in the Yellow Pages. Gould-National Batteries, Inc., Trenton 7, N. J. In Canada, write to Gould-National Batteries of Canada, Ltd., 1819 Yonge Street, Toronto, Ont.

More Power to you from **GOULD**

Electrical World

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NEXT WEEK

TOWER FOUNDATIONS are compacted with explosives.

LATE NEWS ▶ **Buffalo appeals to New York State Power Authority** to relax its restrictions on the allocation of power from the Niagara project aimed at promoting industrial expansion. The authority plans to limit its allocation of power for industrial expansion to companies that will use a minimum of 5 Mw and are located within 25 miles of the new Lewiston power station. But Buffalo Chamber of Commerce points out that there are many smaller companies in the area that probably would expand if they could qualify for the lower cost power. This expansion would create more jobs on the Niagara Frontier. H. W. Pearce of the Buffalo Chamber is recommending to E. V. Stalcup, the Authority's director of power utilization, that the minimum be reduced to 500 kw.

Startup of Elk River boiling-water nuclear plant is delayed by fuel fabrication difficulties. Inspections have shown that some too-deep welds penetrated fuel tubes. This increases the possibility of leakage. All delivered fuel assemblies have been returned to the fabricator for replacement of any parts found defective. Startup of the AEC plant, which will be operated by co-ops in Minnesota, was to take place before February. Now it will probably be during April.

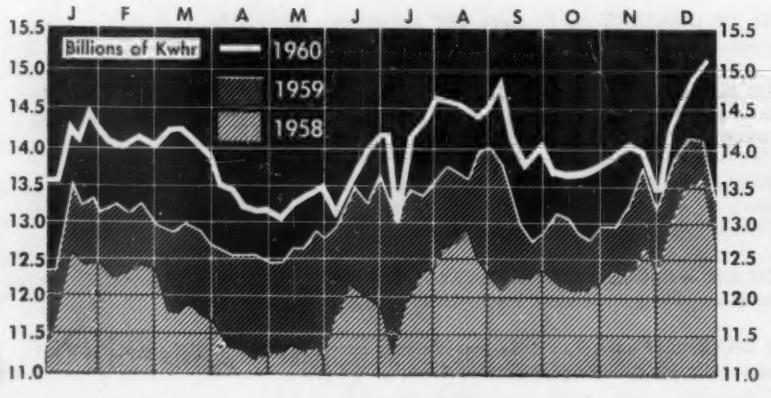
Second of the world's largest steam electric generating units is in operation at the Philip Sporn Plant of the American Electric Power System. The new 500-Mw unit, costing $65 million, is the twin of another AEP System unit operating since last July at Breed Station on the Wabash River in Indiana. The new unit has the world's largest water-cooled generators. High-resistivity water flows through and cools the hollow copper strands that make up the stator coils. The unit operates on steam at 3,500 psi and 1,050F with double reheat to 1,050.

Energy production by Shippingport Atomic Power Station in mid-December was 620 million kwhr, not "nearly a billion kwhr" as reported in *Electrical World,* Dec. 19, p 52.

Trico Electric Cooperative seeks an injunction to prevent Tucson Gas, Electric Light, & Power Co from constructing power line to Titan ICBM base under construction at Tucson, Ariz. The injunction would block the Tucson utility from furnishing power to ten Titan sites. Trico claims it has a certificate of convenience and necessity to serve areas in which the sites are located.

Western New York Nuclear Research Center announces a price list for use of its facilities by industry. Among the prices is a charge of $30,000 per man-year for research to be conducted by the center's staff on behalf of industry.

WEEKLY POWER OUTPUT—Up 13.2% (Week ending Dec. 24), Kwhr 15,114,000,000



Per Cent Change From Previous Year

	Dec. 10	Dec. 17	Dec. 24
Total U. S.	+ 3.1	+ 6.2	+13.2
New Eng.	+ 4.5	+ 7.2	+14.1
Mid. Atlan.	+ 0.6	+ 3.1	+10.3
Cent. Indust.	− 1.9	+ 0.8	+ 8.4
West Cent.	+ 5.3	+ 8.3	+17.0
Southeast	+ 4.0	+11.2	+19.7
South Cent.	+ 8.0	+ 7.8	+13.8
Rocky Mount.	+19.5	+20.2	+23.1
Pacific			
NW	+ 5.2	+ 9.6	+12.0
SW	+ 6.2	+ 4.2	+10.6

Seasonally Adjusted Index 276.7
Week Ago 276.3 Year Ago 258.3

Source: Edison Electric Institute

Supply Lines

POWER CAPACITOR PRICES RETREAT AFTER MARKETPLACE SCRIMMAGE

Power capacitor published prices continued their gyrations at year-end with General Electric Co announcing that it was withdrawing its increase (to $108 for a 50-kvar unit) instituted Dec. 9 and reducing prices to a flat $100 for a 50-kvar unit as of Dec. 22. Prices on 100-kvar units were trimmed from $216 to $200. Changes were also announced for pole-top assemblies and stack rack equipment.

Comparison of the new published prices for fixed pole-top equipment as compared with the Dec. 9 published prices are:

Kvar	Dec. 9 price	Dec. 22 price
300	$ 699	$ 665
450	1,012	963
600	1,325	1,261
900	1,949	1,855
1200	2,572	2,448

In pricing switched, pole-top equipment, $309 per equipment is added to the above prices to cover switches and hardware. In pricing partially-filled racks, the above prices are reduced by $100 per 50-kvar unit for each space not filled.

At the same time, GE said it was reducing published prices from $2.40 to $2.29 per kvar for stack-rack equipments with standard voltages and expulsion fuses.

The new low prices were extended to all orders now on GE's books.

In explaining the new prices, W. G. Hart, manager of power capacitor sales for GE's capacitor department, said these reductions in published prices were caused by the lower market level existing on recent large utility capacitor propositions in Calif., Texas, Ala., and Colo. He said his company will continue its policy of adjusting its published power capacitor prices to the market level and will make these prices available to all customers everywhere.

Other manufacturers who had followed GE's lead in announcing higher prices two weeks earlier were expected to trim prices near the new GE level. The quick turnaround was partially explained by the fact that in late fall and early winter power capacitor sales appear to reach their height. Orders lost then are not easy to recover.

UTILITY PURCHASING DEPARTMENTS MAKE FAIR SHOWING

Electric utility purchasing departments made a fair showing in a recent comprehensive survey of "Purchasing Department Organization and Authority" conducted by the American Management Assn. But AMA cautions that its figures should be used as no more than a guide in comparing one industry with another or even one company with another in the same industry. For guidance only, then, here are a few of the findings:

Utility purchasing costs (including both direct and overhead expenses) amounted to 0.80% of total purchases for the four utilities responding to one part of the questionnaire. This compares with 1.47% for the transportation industry and 2.50% for the construction industry. But it is considerably above the average of

0.46% for the 59 firms from all industries reporting.

Looking at some specific utilities, we find that percentage of purchasing cost to total goods purchased ranged from 3.33% for a gas utility down to 0.25% for a combination electric-gas utility. A straight electric utility reported 0.92%.

Taking a look at the purchasing work forces compared to the total work force, the AMA survey found that utility purchasing departments command about 0.76% of the total work force in a utility, compared with an average of 0.56% for purchasing departments in all of industry. Still, utilities have a smaller proportion of employees in the purchasing departments than does the durable goods industry (0.92%) or the construction industry (1.04%).

In looking into the organization of purchasing departments for all types of industry, the AMA survey found that the top purchasing man reports to the company president in 29% of the firms; the general manager in 33% of the firms; the production manager in 21% of the firms; and the treasurer in 14% of the firms. Looking more specifically at the setup of the purchasing department, the AMA survey found that the average purchasing department for all industry is made up of 50 clerical workers, 24% supervisory employees; 14% buyers, and 1% expeditors.

PURCHASING EXECUTIVES THINK 1961 WILL BE BETTER

Purchasing executives representing all industries expressed cautious optimium that 1961 will be better than last year. However, for the present they see business generally slipping further toward a full-scale recession. These were some of the findings of the December report of the business survey committee of the National Assn of Purchasing Agents. The survey found both new order and production figures had deteriorated during December and were worse than they had been at any time since the 1957-1958 recession.

Unlike the 1957-'58 recession, current business conditions are putting terrific pressure on prices, the purchasing men said. They attribute the downward price trend to keen domestic competition and the threat of foreign imports. The survey for December showed that 14% of the respondents reported they had experienced lower prices, 80% said there had been no change, and 6% told of slight over-all increases.

DOMESTIC FIRM WINS BID FOR LARGEST TURBINE GENERATORS

General Electric Co won a contract to supply two 800-Mw turbine generators to Tennessee Valley Authority at a cost of $30.4 million in competition with one other domestic manufacturer and three foreign manufacturers. The GE bid was evaluated as exceeding the lowest foreign bid by less than half of the 20% margin that TVA allowed domestic firms in the invitation for these bids. TVA noted that the price for the 800-Mw turbines, when ordered in combination, figured out to $19 per kw as compared with $32.22 per kw for the first 500-Mw unit ordered just three years ago. TVA Chairman Herbert D. Vogel praised GE for "its advanced engineering and price-conscious policy." He added, "It is gratifying also to see this demonstration of the ability of American industry to compete successfully in the world market."

All suspension insulators and hardware are designed to work together.

But good design is only the beginning. Unless that design is faithfully reproduced in every part of every piece - - porcelain and metal - - the designed strength will never be fully realized.

At Ohio Brass we've been making porcelain for over half a century. We've been making our own metal components - - in our own foundry - - even longer. Here porcelain and metal aren't just designed for each other, they're *made* for each other.

And if you're interested in service reliability, they're made for you!

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

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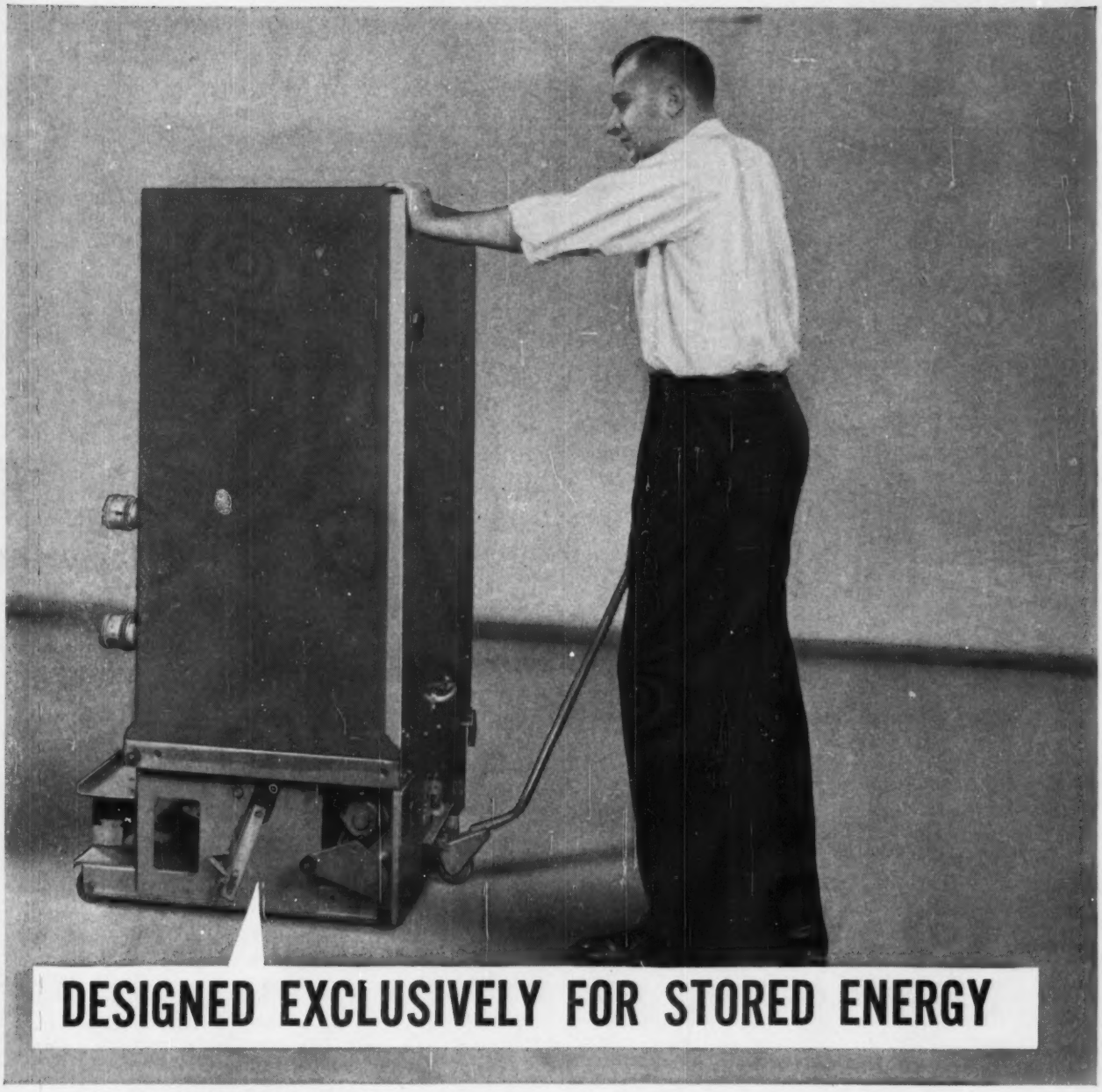
ISOLATED INSTRUMENT COMPARTMENT WITH SEPARATE DOOR
MOST COMPACT AND ACCESSIBLE SWITCHBOARD AVAILABLE
BREAKERS CAN BE DRAWN OUT WITHOUT OPENING DOORS

NOW YOU CAN ALWAYS,

have fast, safe operation of your

Stored energy closing is just one of the many big progressive steps forward you will find in this all-new I-T-E 13.8 kv switchgear. So is the separate, isolated instrument compartment . . . and the closed door drawout . . . and the more compact switchboard! Here is new safety, new long life potential, and new greater assurance of uninterrupted service.

One man can handle the entire maintenance job. The breaker is not only smaller, it's significantly lighter—the result of using new, more modern materials. Phase barriers may be easily removed by one man. Arc chutes can be tilted back. The breaker frame may even be flipped over without assistance. With the huge cable makeup area and the easily accessible bus, this is truly the easiest to maintain 13.8 kv switchgear yet.



ALWAYS, IN ALL WAYS

13.8 kv circuit breakers every time

If you are about to specify new 13.8 kv switchgear, make sure you get all these I-T-E advantages. And right now send for illustrated Bulletin 2800-2B, with complete details. Or contact your nearby I-T-E sales office. I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E | **I-T-E CIRCUIT BREAKER COMPANY**

CHEVROLET IFS FRONT INDEPENDENT SUSPENSION "WALKS" WHEELS OVER TRUCK-BUSTING BUMPS!

Chevrolet truck wheel action on rough road surface, as depicted by 4-stage stop-action photography.

CHEVROLET I.F.S. (FRONT INDEPENDENT SUSPENSION) PROTECTS YOUR PROFITS THESE THREE WAYS:

1 *Rides down high maintenance costs.* When a bump looms up, Chevy's independently suspended front wheels "walk" right over it. Most road shocks and jolts never reach the chassis, cab or body. The truck rides *smoothly,* takes less of a beating, stays in cost-saving shape longer. Your income doesn't dribble away in big repair bills. And you don't lose money through excessive downtime, either.

2 *Rides cargoes over rough spots with less damage . . . minimum loss.* Thanks to those same "walking wheels," loads don't do much bouncing in the body of a '61 Chevy truck. That means you don't have to contend with undue cargo damage that eats away at your earnings. (Chevy's load-tailored *rear* suspension helps protect cargoes, too.) This sure protection for fragile loads—and profits—is standard in 1961 Chevrolet trucks of every weight class.

3 *Rides drivers through with less fatigue—for tighter schedules.* Wait till you see how Chevy front wheel action works to eliminate tiring shimmy and steering-wheel fight. It means that the man at the controls can stay there longer with less fatigue—stay on schedule and do a bigger day's work. (Another reason you can look for faster schedules is that Chevy's bump-beating wheel action allows faster safe speeds on rough roads.)

That gives you an idea of how Chevy Independent Front Suspension works to move you ahead in the money-making department. And it's available in 165 Chevrolet models for '61, from new Corvair 95's to 36,000-lb. GVW tandems. Check it out with a demonstration ride at your Chevrolet dealer's, sometime soon. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

INDEPENDENT FRONT SUSPENSION

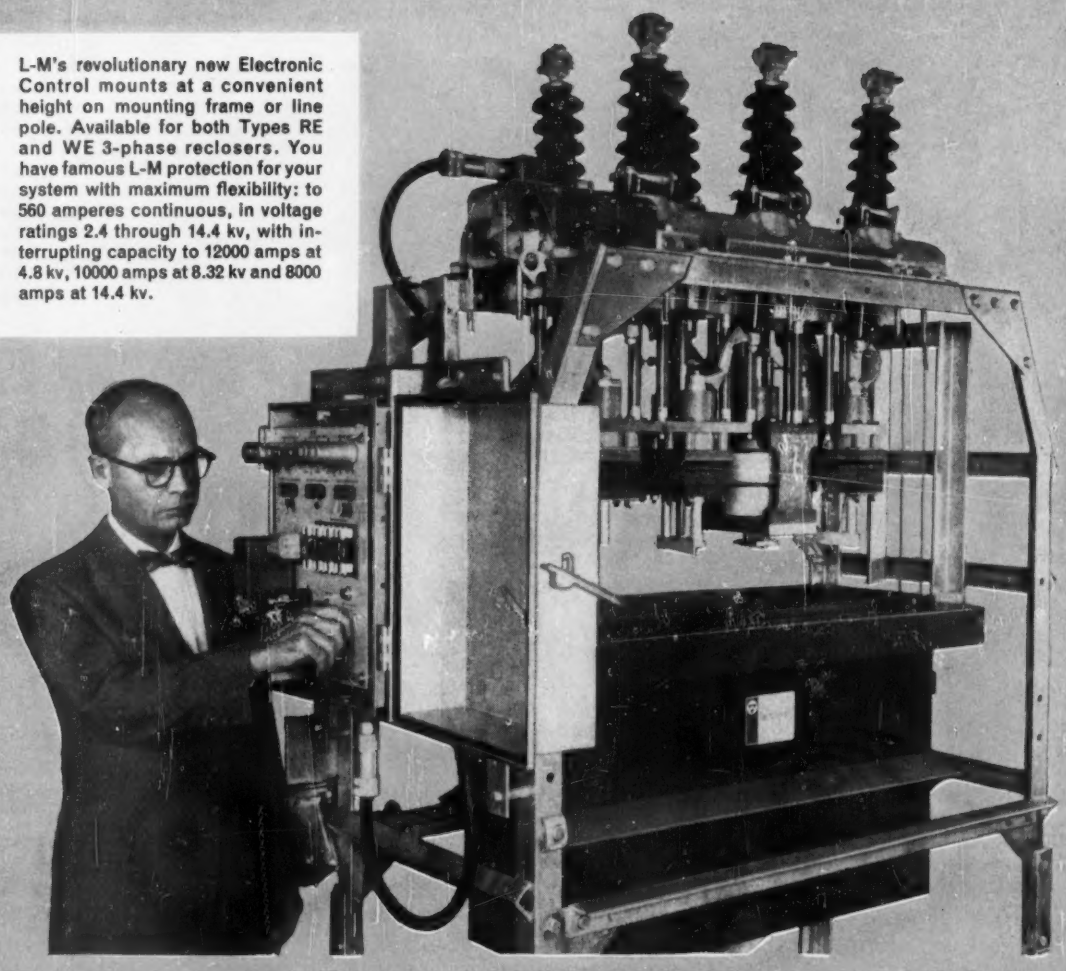
In Chevy, each front wheel, suspended independently, is free to step cleanly over bumps (see left). Each works smoothly to reduce objectionable jolts so characteristic with I-beam axle design (right). Working with load-tailored rear suspensions in every weight class, I.F.S. provides the basis for profit-protecting performance that's unmatched by I-beam axle trucks.

I-BEAM AXLE DESIGN

1961 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

L-M's revolutionary new Electronic Control mounts at a convenient height on mounting frame or line pole. Available for both Types RE and WE 3-phase reclosers. You have famous L-M protection for your system with maximum flexibility: to 560 amperes continuous, in voltage ratings 2.4 through 14.4 kv, with interrupting capacity to 12000 amps at 4.8 kv, 10000 amps at 8.32 kv and 8000 amps at 14.4 kv.

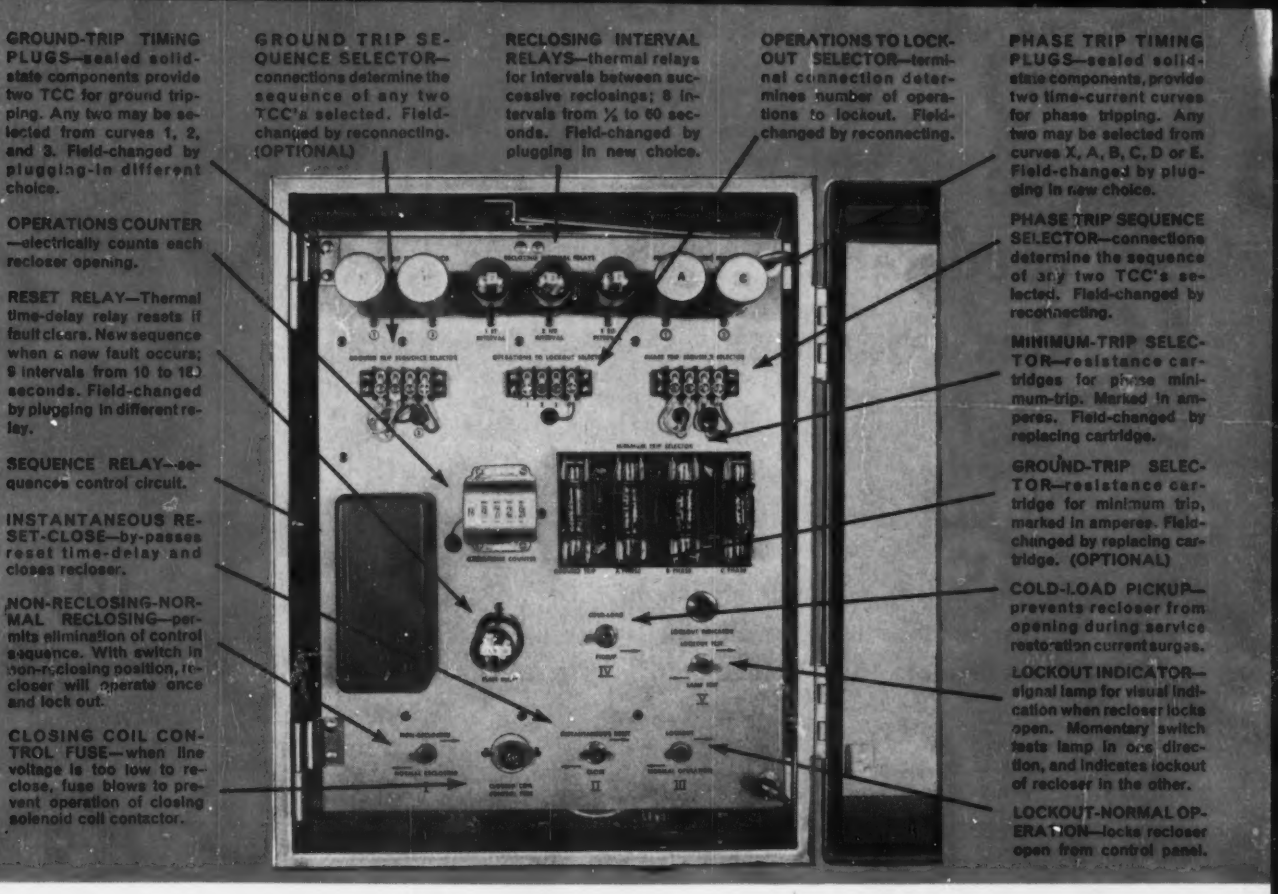


Outstanding Features of L-M Reclosers

- Lowest possible cost—no other device can match L-M's recloser protection for the same money.
- Simple installation—when controls are adjusted you just connect circuit conductors to bushing terminals and recloser is in operation.
- Wholly-contained—requires no auxiliary power supplies or relays whether installed in substation or on pole top.

Now
New L-M Electronic Control Adds:

- Greater control flexibility—minimum trip current, number of operations to lockout, number of fast and retarded operations and time-current characteristics field-changed without untanking or interrupting service.
- Greater Application Flexibility—the basic Electronic control is complete with all control possibilities built in except optional ground trip. All possible protection is contained in one unit.
- Complete test-ability—control may be tested with 120 volts AC with very low current.
- Ground Level Operation—Control panel may be mounted independent of recloser.
- Simplified Coordination—L-M Electronic control offers special operating characteristics apart from time-current characteristics presently offered.


GROUND-TRIP TIMING PLUGS—sealed solid-state components provide two TCC for ground tripping. Any two may be selected from curves 1, 2, and 3. Field-changed by plugging-in different choice.
OPERATIONS COUNTER—electrically counts each recloser opening.
RESET RELAY—Thermal time-delay relay resets if fault clears. New sequence when a new fault occurs; 9 intervals from 10 to 180 seconds. Field-changed by plugging in different relay.
SEQUENCE RELAY—sequences control circuit.
INSTANTANEOUS RESET-CLOSE—by-passes reset time-delay and closes recloser.
NON-RECLOSING-NORMAL RECLOSING—permits elimination of control sequence. With switch in non-reclosing position, recloser will operate once and lock out.
CLOSING COIL CONTROL FUSE—when line voltage is too low to reclose, fuse blows to prevent operation of closing solenoid coil contactor.
GROUND TRIP SEQUENCE SELECTOR—connections determine the sequence of any two TCC's selected. Field-changed by reconnecting. (OPTIONAL)
RECLOSING INTERVAL RELAYS—thermal relays for intervals between successive reclosings; 8 intervals from ½ to 60 seconds. Field-changed by plugging in new choice.
OPERATIONS TO LOCK-OUT SELECTOR—terminal connection determines number of operations to lockout. Field-changed by reconnecting.
PHASE TRIP TIMING PLUGS—sealed solid-state components, provide two time-current curves for phase tripping. Any two may be selected from curves X, A, B, C, D or E. Field-changed by plugging in new choice.
PHASE TRIP SEQUENCE SELECTOR—connections determine the sequence of any two TCC's selected. Field-changed by reconnecting.
MINIMUM-TRIP SELECTOR—resistance cartridges for phase minimum-trip. Marked in amperes. Field-changed by replacing cartridge.
GROUND-TRIP SELECTOR—resistance cartridge for minimum trip, marked in amperes. Field-changed by replacing cartridge. (OPTIONAL)
COLD-LOAD PICKUP—prevents recloser from opening during service restoration current surges.
LOCKOUT INDICATOR—signal lamp for visual indication when recloser locks open. Momentary switch tests lamp in one direction, and indicates lockout of recloser in the other.
LOCKOUT-NORMAL OPERATION—locks recloser open from control panel.

L-M's New Electronic Control Provides Greater Flexibility For Reclosers

Relay, System Protection and Substation Engineers will find that the new Type RE and WE Reclosers offer the ultimate in coordinated system protection.

by **N. K. DELANEY**
Product Manager,
Switchgear and Capacitors
Line Material Industries

Oil Circuit Reclosers as developed by Line Material some years ago have been universally accepted as tremendously efficient, cost-saving protection for distribution lines and substations.

One reason for L-M's outstanding leadership in reclosers has been the L-M-developed hydraulic control, which is extremely dependable, and well accepted.

Today Line Material announces another revolutionary new engineering development—the L-M *Electronic* Control.

The *Electronic* control consists of a solid-state transistorized sensing and control device: time-delay relays for resetting and reclosing; provisions for ground current tripping; test and control switches; and plug-in components to provide for changing time-current curves and sequences without service interruptions. The L-M Electronic control provides greater flexibility, greater accessibility, and a wider choice of time-current curves than have been available even with L-M's outstanding hydraulic control.

Now Get Electronic Coordination

Get complete details on this outstanding improvement by Line Material in automatic line protection. Ask the L-M Field Engineer for Product Information Bulletin CR1WE, and ideas on how you can take advantage of this remarkable new development in oil circuit reclosers. Call the nearest L-M office; or phone or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13, Canada.

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McGRAW-EDISON COMPANY

Reclosers, Sectionalizers, and Oil Switches

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PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

Our 50th Year 1911-1961

L-M Feeder-Pak® Provides Compact, Low-Cost, Low-Voltage-Side Unit

Shipped in pre-wired, assembled sections, ready for fast, economical installation in substation as complete 15 kv feeder unit.

by **W. V. SWAN**, Product Manager
Power Switching Equipment
Line Material Industries

The new L-M Feeder-Pak is a complete unit for the low-voltage side of a substation. It provides support for feeder conductors, disconnect and by-pass switches, lightning arresters, current transformers, and substation-type R or W three-phase Kyle heavy-duty recloser.

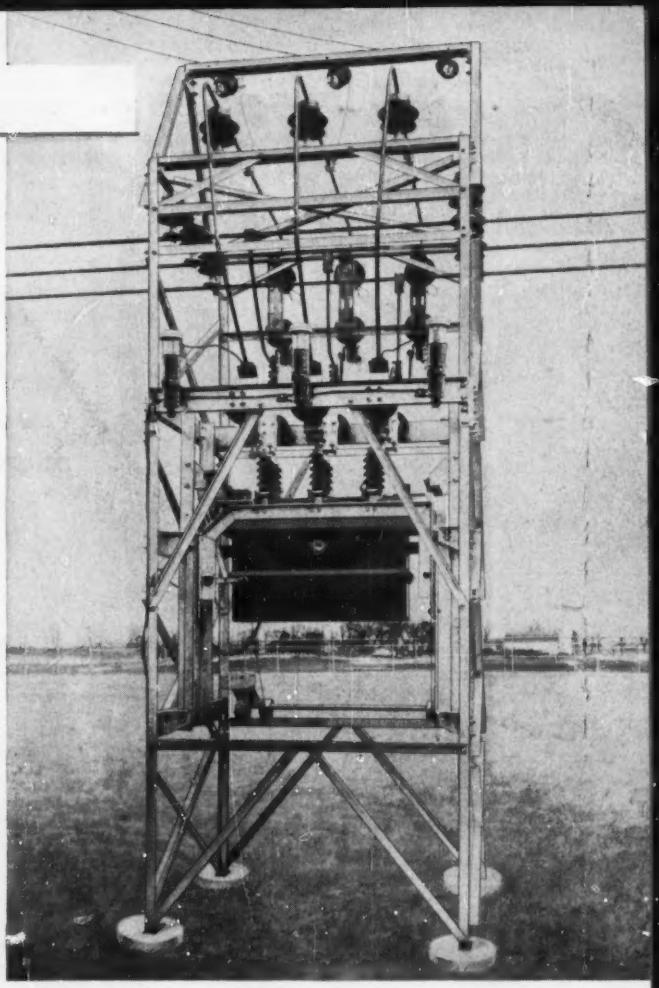
Neat, Compact

The unit has a very neat appearance. It is compact, easy to install. The whole unit comes in easy-to-handle crates. Additional units can easily be added when additional feeders are needed. Or units can be removed to other locations.

The Feeder-Pak costs about the same as the *materials* for a conventional open-type feeder position, but installation costs are far lower. Bus, insulators, switches, and arresters are all in place. No concrete pad is needed—only footings for the four legs. And it takes less land area—it's only 5 feet, 4 inches square!

Easy to Install

To erect the L-M Feeder-Pak, simply bolt the lower section to the concrete footings; set the upper section into the lower section and bolt; raise the recloser into position with the hoisting mechanism included in the lower section. Self-aligning bayonet-type contacts work automatically as recloser is raised into position. Automatic interlock prevents lowering the recloser until recloser contacts are opened.



THE NEW L-M FEEDER-PAK. The lower pre-assembled steel section contains the recloser, and recloser lifting frame and lifting mechanism. The unit is neat, compact. Base is only 5 feet, 4 inches square. It saves land, cuts installation and maintenance time. No mounting pad is required—just footings for the four legs.

L-M Feeder-Pak Features

1. With Kyle Type R or W recloser provides complete structure and equipment for low-voltage side of the substation.

2. Complete; compact; neat. Saves land costs; requires no pad; cuts installation man-hours.

3. Shipped as partly assembled units, crated for easy handling. Switches, arresters, and recloser disconnects are all pre-wired, and installed. Current transformers if desired.

4. Additional feeder positions are easy to add; or the Feeder-Pak may be removed to another location if desired.

5. Recloser lifting frame and tank lifting device make recloser maintenance safe and simple.

LINE MATERIAL® Industries
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Substations and Power Switching Equipment®

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DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
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Editorial Comment

JANUARY 2, 1961

Steel Index Goes Underground; Power Should Take Warning

Steelmakers finally have broken away from their traditional reporting of weekly industry production in terms of percent of capacity. They have made the change while in the depressing shadow of a cloud of temporarily low output, which, expressed in the traditional terms, painted a needlessly somber picture.

We live today in a world of business statistics. Figures, it is said, can be made to prove any point desired. And with steel, considered a bellwether industry in the US economy, depicted as a sick, sick business by many political economists, we don't wonder steelmen wanted to get off the hot seat.

The electric utility business could well be in a similar vulnerable position. More and more economists are looking to electric power production as another highly significant index in their array of numbers.

With power production moving upward constantly under stimuli we all know well, there has been little reason to fear that self-seeking or incompetent people will be able to twist the data for their own ends. Proof of how it *can* be twisted, however, can be obtained readily. An obvious example is to calculate weekly power production on the same basis just abandoned by the steel industry, that is, by comparing it against possible production by full reported capacity as of the end of the previous year.

Using this method for 1960, it can be shown that the US power industry produced, during one week this year, at only 49.0% of capacity, and during the highest week, reached only 56.5%! Yet few detractors would call the electric utilities sick.

These numbers tell a completely misleading story. If the method was nonsensical for steel, it is doubly so for electric power, and no power statistician in command of his senses would attempt its use.

Yet, note: the steel people, trapped by their method, tried once before to reject it. But they continued to publish their year-end industry capacity, and economists and business writers, familiar with the old index, blithely continued to calculate it. So what has the steel industry done now? They've decided to drop the reporting of the year-end capacity, making the calculation nearly impossible. They've achieved their goal of destroying the index, but at the cost of putting valuable capacity statistics under wraps.

The moral is very plain. Changes in political climate, particularly now with the ascendency of "liberal" economists sitting on the right hand of the new Administration, may well mean a more careful (or careless) scrutiny of electric power data. We must not be startled if some of these planners openly attempt to warp basic power statistics to prove their own theses.

Yet we cannot believe that the proper approach to such a threat is to decrease or to muddy the data now being reported and calculated, as steel has felt compelled to do. Electric power statistics are extremely valuable in their present form; they are being refined and improved constantly by highly competent practitioners. Any restriction of these efforts would constitute a loss to the industry as a whole.

The efforts to improve data reporting must continue, even while vigilance against misuse of the data must be redoubled. There must be no retreat behind an iron curtain of statistical silence.

Dakotas Area Power Needs Studied

Study recommends co-ops build 200-Mw steam unit at Garrison Dam by 1966 as first step. Private companies, co-operatives and USBR also should pool and wheel power

Two investor-owned utilities and three cooperatives serving parts of the Dakotas and Minnesota will need 1,250 Mw of new generating capacity within the next 18 years, and should have pooling and wheeling agreements for maximum utilization of present and future generating and transmission facilities.

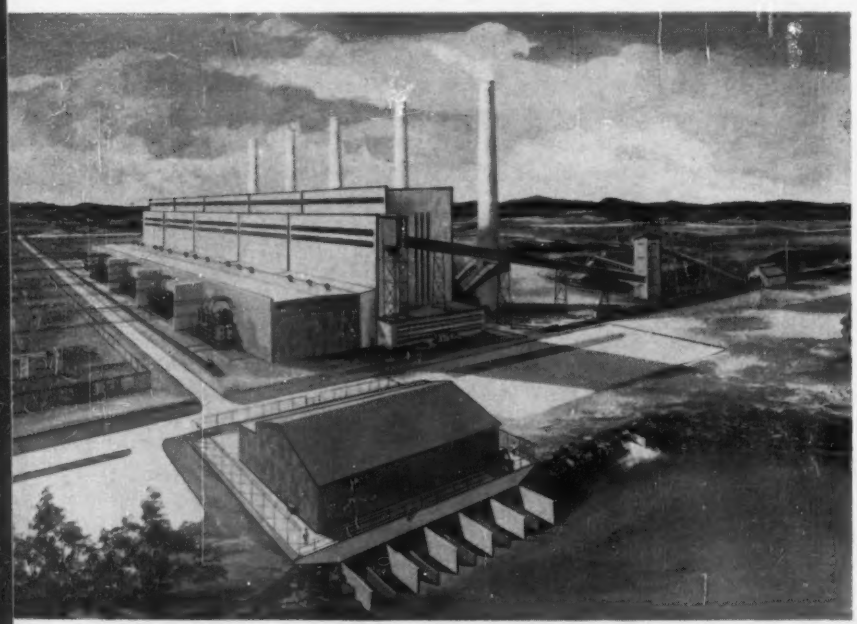
The private companies, Otter Tail Power Co and Northern States Power Co (North Dakota area only), will need some 80 Mw of new capacity by 1964 to meet predicted loads. The rural systems, Central Power Electric Cooperative, Dakotas Electric Cooperative, and Minnkota Power Cooperative, will require some 100 Mw of new capacity for projected loads.

The recommended first step for the cooperatives is the building of a 200-Mw unit in the area of the Bureau of Reclamation's Garrison Dam in North Dakota. In addition, excess capacity in the Bureau's existing 230-kv and 115-kv transmission lines should be used to the maximum extent possible in delivering the output of the proposed plant. This arrangement will result in a smaller capital outlay for new transmission lines and a minimum cost for delivery of fuel to the plant.

These recommendations are contained in a report on the North Dakota Area Power Study presented at the North Dakota Area Power Conference, Grand Forks, N. D., by A. Matiuk, vice president, and T. Y. Mullen, chief mechanical engineer, Burns and Roe, Inc. This study, made over the past year, was reported as the latest move during several years of effort by the companies and cooperatives to find a common and advantageous solution to their power and transmission problems. Burns and Roe added that Paul Weir Co cooperated in the study.

The report calls for work to be started immediately if the cooperatives' 200-Mw unit is to be ready for loads in 1966. Thus, problems of site and rights-of-way, financing, fuel supply and pooling and wheeling agreements must be solved. The private companies could meet expected power needs in 1964 by installing additional capacity or through other arrangements.

Based on financing through Rural Electrification Administration, the proposed 200-Mw, 1,800-psi, 1,000/1,000-F unit installed near Garrison Dam will produce energy at the busbar varying from 5.1 mills at 40% load factor to 3.6 mills at 70% load factor. The report concludes that each generating unit or transmission facility should be financed entirely either by the private companies or by the cooperatives because of differences in financing procedures and legal restrictions. However, this will not reduce the advantages of joint planning and timing of future facilities, but will simplify the problems of setting up and operating the area-wide system comprising the five utilities.



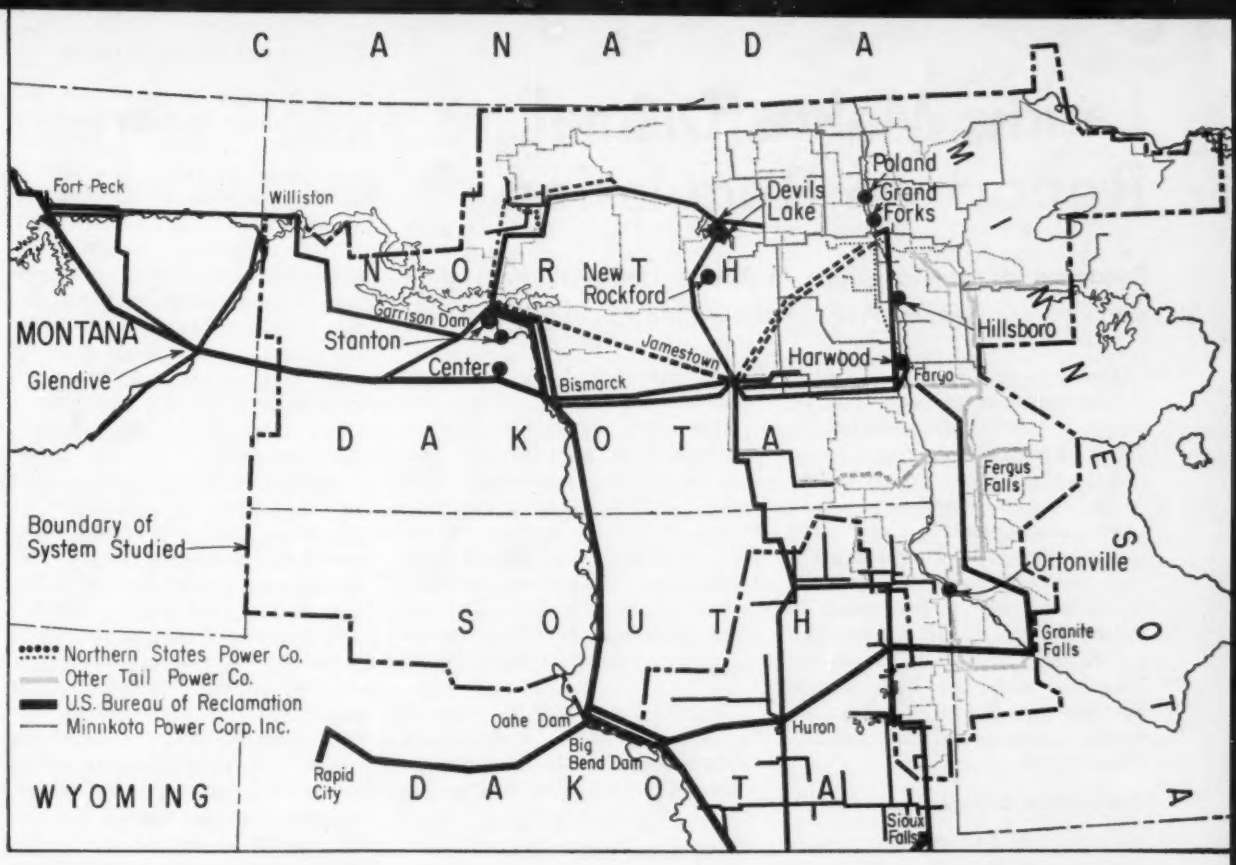
PROPOSED 200-MW STEAM STATION near Garrison Dam would be first step in joint cooperative-private utility planning for North Dakota area's power needs.

Five Systems Studied as Pool

The study was confined to the power supply requirements of the entire systems (not just the North Dakota portions) of the three cooperatives and Otter Tail Power; and the North Dakota properties of Northern States Power. The entire area was treated as a single service area to allow the determination of generating and transmission requirements which would provide the most economical and reliable power supply to the entire area. Advantages of treating the five power suppliers as a single pool were said to include:

1. Lower investment and power production costs through use of larger units.
2. Reduction of power transmission losses through the supplying of loads from the closest transmission line.
3. Diversification of loads leading to less installed capacity to carry peak loads, less transmission, and less reserve capacity.
4. Increased reliability because of improved interconnection.
5. Reduced frequency of new construction by each supplier.

These advantages will accrue to each utility, the report states, if



PRINCIPAL TRANSMISSION FACILITIES included in the survey are shown here, as well as the boundary of the area studied. The final report was based on eight different plans for the area that were set up and evaluated by consultant

construction of generating and transmission facilities is planned, financed, constructed and operated on an area-wide basis rather than on an individual service area basis as is now generally being done in the area. Based on existing loads and future loads, Burns and Roe determined the growth of each utility. They estimated that about 1,250 Mw of additional generating capacity will be needed to serve this area within the next 18 years.

Tentative areas for future generating plants selected for more detailed field investigation include locations in North Dakota near Harwood, Hillsboro, Poland, Grand Forks, Devils Lake, New Rockford and Garrison Dam, and Ortonville, Minn. In some cases, the supply of cooling water will limit the generating capacity which could be installed on the sites. The areas inspected included James River, Red River of the North, Devils Lake, and Missouri River.

Paul Weir Co made an investigation of lignite outcroppings, existing and abandoned lignite mines, and potential lignite deposits. Results indicate that at the most favorable site about 117 million tons of recoverable lignite are available under an overburden between 10 and 60 ft deep. An additional 73 million tons of recoverable lignite also are available.

This total of 190 million tons is considerably more than the estimated 31 million tons required by new capacity during the next 18 years. The company also studied commercial freight rates, construction of privately-owned rail facilities, trucking costs, and conveyor systems from mine to power plant.

Burns and Roe set up and evaluated eight different plans for new generating facilities in the area within the next 18 years. They compared installation of units at a single site with units throughout the area, using capacities ranging from 100 to 250 Mw. Consideration also was given to use of excess capacity of USBR's transmission facilities.

Application for Texas-Calif. Pipeline Filed

Applications seeking authorization of the long-talked-about Tennessee Gas Transmission Co 1,600-mile pipeline through Mexico to join south Texas reserves and the Los Angeles area have been filed with the Federal Power Commission by two Tennessee Gas subsidiaries and Southern California Edison Co. The utility wants to buy boiler gas from Humble Oil & Refining in Texas.

Opposition to the $225-million project has been promised by Western Pipe Line Co, and by the Los Angeles gas distributors who say they can meet Edison's needs. Edison wants a firm gas supply, at stable prices. To meet smog control regulations the utility has to use gas as a fuel for at least half the year.

Landis Makes Dismal Report on Regulation

Recommends special office in White House to help plan and oversee development of the nation's energy resources

President-elect John F. Kennedy is considering a proposal that he create a special office within the White House to help him oversee and plan the development of the nation's energy resources.

The recommendation was made by Dean James M. Landis in a 87-page report prepared for Kennedy on ways to improve and speed up the operations of the seven major government regulatory agencies. Landis is a former Dean of the Harvard Law School and a former member of three of the regulatory commissions.

Consolidate Energy Regulation

Landis told Kennedy that policies governing production, conservation and development of various forms of energy are now worked out separately by too many government agencies and ought to be coordinated by a single official close to the President.

He pointed out that electric power in its various forms falls under the regulations of the Federal Power Commission, the Department of Interior, the Army Engineers, and the Tennessee Valley Authority. Surface transportation of fuels for power production is the responsibility of the Interstate Commerce Commission and Federal Maritime Board. The Atomic Energy Commission deals with energy from fissionable materials, while conservation rests mainly with Interior and fuel imports with the State Department and Tariff Commission.

Landis said an Office for the Coordination and Development of Energy Policy within the White House could help the President in formulating a single, all-encompassing policy on both the use and conservation of energy. Even more important, he said, it could handle the task of overseeing development of new sources of energy, such as hydrogenation of coal and oil-bearing rock, wider employment of atomic power and the distillation of fresh water from sea water.

This office would not supplant the regulatory agencies nor take over any of their rate-making, rule-making or other adjudicatory functions. It would operate in the policy field only and should have, Landis said, "the constant personal support of the President." In time, and if experience dictates, he added, it might be raised to cabinet-level status.

As for the regulatory agencies themselves, Landis found many shortcomings in their operations aside from ineffective policy-making.

Landis Rates FPC "Worst"

He gave the worst marks in his report to the Federal Power Commission and the best to the Securities & Exchange Commission. He said the FPC is "without question" the worst example in the federal government of a "breakdown in the administrative process."

It is farthest behind in its work—the backlog of pending cases last year end was four times that of 1957—yet "has literally done nothing" to reduce delays in its procedures except issued "pious expressions" of intentions, Landis said.

Worse yet, he charged, it is guilty of a "patent failure" to execute natural gas laws to protect the consumer and has been "substantially contemptuous" of the US Supreme Court and other federal courts in refusing to do so. He said this is cause for removal from a practical government standpoint, though a point lawyers might argue.

He said FPC's recent action in promulgating area rates on natural gas, "whether ultimately legal or not, has come far too late to protect the consumer."

Landis said Kennedy should consider asking Congress to increase the FPC's membership from five to seven, to allow its members to sit in two panels of three members each and to vest final decisions in these panels in order to clear up the Commission's enormous backlog of cases.

"But primarily," Landis said, "leadership and power must be given to its chairman, and qualified and dedicated members with the consumer interest at heart must be called into service to correct what has developed into the most dismal failure in our time of the administrative process."

Landis said most of SEC's faults are simple ones and that most of the delays that characterize its operations "stem from the fact that more than any other agency, it has been starved for appropriations."

He urged that the agency adopt similar forms of registration for securities, cease "lint-picking" in passing on deficiency letters and crack down harder on so-called investment advisers, "many of whom have morals not exceeding those of tipsters at the race track." He also said Congress should grant the Commission's request for additional power to force disclosures with respect to over-the-counter securities.

Many Improvements Recommended

Landis made these recommendations for improving the operations of the regulatory agencies generally:

- The terms of commissioners should be extended—perhaps up to ten years—to attract better men. Tenure is more important than salary increases, but the commissioners should be given a modest entertainment allowance.
- The President should issue an executive order applicable to all agencies dealing with ethics and the duty to reject improper attempts at influence-peddling by persons interested in pending cases.
- An office should be created in the White House to help see that the regulatory agencies operate with efficiency. The President should also promote organization of an Administrative Conference of the United States which would provide advice on regulatory procedures and on the qualifications of prospective commissioners, operating in much the same way as the Judicial Conference of the United States does.

This Month in Europe . . .

Winter Peaks Strain British Capacity

J. H. M. SYKES, Overseas Engineering Correspondent, London

The winter, so far, has formed a severe testing time for Britain's government-owned electric power system. Because of inadequate planning five years ago, generating plant in England and Wales is barely able to supply the load this winter. The load had already risen by 9.8% in the preceding statistical year, compared with the normal 7%.

At the World Power Conference meeting in Madrid, British engineers —not only from the supply side— said that in recent years they had gotten by only through using the overload capacity of generating plant. Planners from other nations also said that under-estimation had been common: only Sweden said that forecasts made ten years ago were proving accurate.

In the light of the narrow shave in meeting winter demand, what are Britain's plans for the future?

The Central Electricity Generating Board's program now is for the installation of 11,358 Mw of new plant, covering 23 stations in the five years 1960-'64. Five have started operation, and four are additions to existing stations.

Atomic power will carry a heavy share of Britain's future requirements. A new nuclear station will be constructed at Sizewell in Suffolk on the east coast of England. The English Electric-Babcock & Wilcox-Taylor Woodrow Atomic Power Group, now engaged in building Hinkley Point, holds the contract. The 580-Mw nuclear plant is scheduled for operation in 1965-'66. The two carbon dioxide gas-cooled graphite moderated reactors will use natural uranium as fuel.

Two Atom Plants Start This Year

In 1961 the first two of Britain's major nuclear stations will be commissioned: Bradwell in Essex (300 Mw) and Berkeley in Gloucestershire (275 Mw). Others in the later stages of construction are Hinkley Point (500 Mw), Hunterston (South of Scotland Electricity Board, 300 Mw). Work is in progress at Trawsfynydd in Wales (500 Mw) and at the Dungeness station on the south coast, in Kent (550 Mw).

But not everyone is happy with the progress. One of Britain's leading Sunday newspapers, in November, commented on the present nuclear program as follows:

"When the newest station, at Sizewell, starts up, 10% of the country's present generating capacity will be nuclear powered. There is no doubt that this capacity could have been provided more cheaply by conventional coal-burning stations. It is virtually certain that the present price of nuclear power stations will never be competitive. Moreover, the advanced gas-cooled reactor system which was to have followed has encountered severe technical difficulties, and may now never offer the cheaper nuclear power promised. Nevertheless, the Central Electricity Generating Board continues, at the Government's behest, to place orders for huge, uneconomic installations, keeping teams of highly trained men in industry constantly preparing tenders for out-of-date designs, instead of getting on with research and the development of new types."

As a counter to this argument, Sir Christopher Hinton, head of the CEGB, has firmly stated that nuclear power will be competitive with power from conventional stations by about 1968. It must be added that the cost per installed kilowatt has fallen with each new contract.

May Begin New Pumped Storage

But nuclear power isn't the only area of development. The first pumped storage station in Britain at Ffestiniog in North Wales will come into partial operation in 1961. One or more of its four 75-Mw reversible pump turbine units are scheduled for completion during the year. Construction on a 400-Mw pumped storage station in Scotland may be started during the year.

Apart from provision of generating plant, 1961 will be an exciting year in electricity supply in Britain for several reasons. The first dry cooling tower to be installed in Britain, among the first in the world, will come into operation in connection with a 120-Mw set at Rugeley power station. If this is successful, it will mean that the necessity for siting all generating plants near rivers—and there are few rivers in Britain large enough for the 2,000-Mw stations now being planned— will to some extent disappear.

In the field of transmission, Britain's first 380-kv line, a conversion of a section of the 275-kv supergrid to a higher voltage, will be commissioned during the year, and will herald wholesale conversion at least to 380 kv in the next few years. Experimental work on 500 kv continues.

More Dc Projects Considered

The major event in the transmission field will undoubtedly be the commissioning of the 160-Mw, 200-kv cross-Channel link joining Britain with France. There is already talk of further dc links. Towards this end a major direct current experimental station of about 50-Mw capacity is being built at Brighton on the south coast.

This new dc test project is so planned that power can be sent out from one of the two converter bridges on to nearby 132-kv grid lines out into the system and back again to the bridge, thus gaining much-needed knowledge about dc overhead line transmission. The ratings of the bridges will be 60 kv, 800 amp, and synthetic testing will allow for an equivalent level of 70 Mw of transmission between the two. A second stage will allow for a 120-kv, 1,100-amp power exchange using two transformers back-to-back, at zero power factor.

A member of the Electricity Council, Professor R. S. Edwards, in talking of future planning, recently said that: "Today (in Britain) practically the whole of industry and commerce, 95% of the homes, and over 85% of the farms are already using the public electricity supply. The rate at which new consumers are connected must soon begin to decline. Therefore, although over-all demand is at present rising as briskly as ever, the industry is working to a generating program slightly below the trend line, on the assumption that any consistent departure from it is more likely to be downwards than upwards."

News Scope

RATES AND REGULATION—Pennsylvania PUC approves $500,000 reduction in annual rates of West Penn Power Co as latest step in study of state utility earnings. Expected to be restricted to the utility's 350,000 residential customers, the cut will become effective after West Penn submits a new schedule of rates. Two other utilities, Duquesne Light Co and Pennsylvania Power & Light Co, are still being studied informally... **Toledo, Ohio, hires** special consultant to study Toledo Edison Co request for rate increase averaging about 15% on 102,000 residential and commercial customers in Toledo. Ohio PUC staff finds requests would give Toledo Edison 5.23% on $63,638,608 rate base, while utility claims return would be 4.23% on $67,486,000. Difference in rate bases results largely from different depreciation allowances... **Dallas P&L seeks rate increase** that would boost average residential rate about 6% but exempt customers from effect of upcoming rise in utility fuel costs. Under request, present 60¢ minimum of 12 kwhr or less would be replaced by $1.20 minimum on 24 kwhr or less . . . **Florida Railroad & Public Utilities Commission** orders Florida Power & Light Co to cut annual rates $6,254,000 to bring return in line with the 6.98% previously approved by the Commission. A Commission spokesman said the utility's earning had been running between 7.5 and 8% recently. Distribution of the reduction was left to utility management. Although FP&L disagrees with the Commission's calculations, it will not contest the order and is submitting new rate schedules.

CONSTRUCTION PLANS—Dayton P&L will build new 138-kv interconnection with Cincinnati Gas & Electric Co, following 5-hr, 24-county black-out last month. Dayton P&L already has two 69-kv ties with Cincinnati G&E. City of Dayton is also considering purchase of diesel generator for city's water-pumping plant as hedge against future outage . . . **Douglas County (Wash.) PUD** will seek federal license for construction of Wells Dam on Columbia River. Puget Sound Power & Light Co is financing engineering and planning for the project under pact which gives it large block of power from the 560-Mw run-of-river dam. Pacific Power & Light Co, Portland General Electric Co, and Washington Water Power Co may also join in preliminary financing arrangements . . . **Colorado-Ute Electric Assn will borrow $2,920,000** from REA to build its own transmission lines from USBR Collbran project at Molina, Colo., to Montrose, Colo. The 90-mile, 115-kv line and a 40-mile, 69-kv line to the Grand Valley Rural Electric Assn will tap all the power from the new dam, expected to produce some 68 million kwhr annually . . . **Soviet Union and United Arab Republic** announce plans to boost planned capacity of High Aswan Dam from 2,100 to 2,400 Mw.

BIG, BUT NOT THAT BIG—The largest USSR single-shaft steam turbine, a 325-Mw unit for the Cherepetsk Power Station near Moscow, has been successfully tested at the Leningrad Engineering Works, according to a report by *Tass*, the official Soviet news agency. *Tass* claims that, on the basis of published figures, the turbine's capacity is 75 Mw larger than a Westinghouse Electric Corp unit previously considered the largest of this type.

Designer Vaily Naumov describes the unit as a three-cylinder condensing turbine for operation in block. Its uniflow boiler has an hourly capacity of 1.9 million lb of steam. Initial pressure is 3,500 psi at 1,075F. The unit will serve as prototype for a 500-Mw unit.

A spokesman for Westinghouse told EW that, to the best of its knowledge, the largest single-shaft turbine ever shop tested by a US manufacturer is a 325-Mw, 2,000-psi, 1,000F single reheat unit built by Westinghouse for Arkansas Power & Light Co for the Helena Station. Maximum throttle steam flow was 2.32 million lb per hour. The unit was shipped to Arkansas P&L in July, 1960.

Dateline . . . Olympia, Wash. (*Continued from page 5*)

tacked as "not in the public interest" by the Washington PUD Assn. As a counter-measure, the Assn, at its recent annual meeting, empowered its legislative committee to work for a bill seeking to restrict political activity by the investor-owned companies in the state.

Another bill scheduled for introduction would prevent one utility from invading the territory of another. Such a bill was sponsored by Puget Sound Power & Light Co in the 1959 legislature to stop inroads into its service territory by Seattle and Tacoma City Light. The cities were able to defeat the bill, with PUD support, but indications are that PUD support may not be solid in the 1961 session, with Centralia City Light invading what is now PUD territory.

Tacoma, Wash.—City Light is pressing for an early court test of an initiative, approved by voters Nov. 8, that would block construction of all hydroelectric projects on the Cowlitz River and other tributaries of the lower Columbia.

The word is out that Tacoma might precipitate the court test by attempting to sell a small bond issue for Mossyrock Dam—which might not be too popular since the initiative. There is also a possibility that there is a way to take the case directly to the Washington Supreme Court.

REGULATORY COMMISSIONERS, including these from 49 of the 50 states and from Washington, D. C., Puerto Rico, meet at Las Vegas's Stardust Hotel to review their judicial functions in issuing public utility industry regulations

Urge Protecting Free Enterprise

NARUC officers tell members at Las Vegas their role as judges include more than fending high rates from the consumer

Free enterprise will survive and grow in utility company management and ownership only if public commissions issue sound regulations, the 72nd annual convention of the National Assn of Railroad & Utility Commissioners was told recently at Las Vegas, Nev.

The two-pronged responsibility of commissions—to the public and to regulated industries serving the public—was stressed by the NARUC's outgoing officers and their successors.

"Each commissioner must see to it that the consumer gets good and faithful service without discrimination," said Peter F. Mitchell, California commissioner and NARUC president-elect. "And I have said many times in public that a company that is starved financially is a public futility, rather than a public utility."

Preserving the interests of both the investor and the consumer is perhaps our greatest job as commissioners, Mitchell said. He pointed out that Supreme Court decisions have consistently placed the commissions between the consumers and investors to adjudicate so that both were properly compensated.

Responsible for Future

The role of commissions in maintaining the financial integrity of utilities was stressed also by David Brackman, Massachusetts commissioner and NARUC vice president. The commissions' responsibilities in this role, he said, are as great as those in guarding the public against excessive rates.

"Society, in general, benefits most when regulation serves to encourage research, innovation, and general growth in an industry," Brackman continued. "But a commission fails in its public responsibility when it succumbs to the temptation to sacrifice the future for the present."

Commissioners, he said, are well aware that about 50% of every rate hike does not stay with the utility company but goes to the federal government as taxes. Public utility commissioners therefore must bring this fact to public attention in their insistence that increasing rates only reflect rising taxes and costs.

The increasing scope of a commission's duties today require such a body to act like a judiciary, Brackman continued. In acting like a judge, a commissioner must acquire a judge's skill in considering a great variety of subjects and the many interests involved so as to arrive at the most equitable decision humanly possible in the circumstances, he concluded.

The reports of various committees given to the convention follow:

Nuclear Energy—In assuming radiation controls under the new Section 274 of the Atomic Energy Act, New York, California, and Texas appear to be well ahead of other states. But Kentucky could be first to assume control, having

(*Continued on page* 62)

Half-Capacity Main-Shaft-Driven

Capital costs, equipment availability, efficiencies show best in study on 265-Mw, 2,400-psig, 1,050/1,000-F unit

J. C. **BERES**, Mechanical Technical Engineer,
R. W. **POTTS**, Mechanical Engineer, Commonwealth Associates, Inc, Jackson, Mich.

Two half-capacity, 3,600-rpm boiler feed pumps, each driven through a variable speed coupling by the main generator turbines, have proved to be the most economical boiler feed pump arrangement and drive for a 265,000-kw cross-compound, four-flow turbine-generator. Initial steam conditions are 2,400 psig, 1,050F and 1,000F reheat.

One pump will be connected to the high pressure-low pressure turbine-generator shaft extension; the other to the intermediate-pressure, low-pressure turbine-generator shaft extension. Geared driven main exciters and one one-sixth size, full-pressure, motor-driven start-up pump are part of the arrangement.

Three basic boiler feed pump drives are used for large capacity units: Electric motor, auxiliary steam turbine, and main turbine-generator shaft. Several successful arrangements of pumping equipment have been used with each type of drive. The size and type of turbine-generator, load variation, and fuel cost are factors influencing final choice of equipment.

Criteria Established

As a basis for evaluation, six criteria were established:

1. The net kw capability with any of the boiler feed pump drive arrangements will be the same.

2. An average unit capacity factor will be 0.63 for 35-year life.

3. Expected coal cost will be 40¢ per million Btu at the start-up date and will increase at the rate of 2% per year for the 35-year life.

4. Reliability of arrangements will be comparable as far as possible. When this was not practicable, an outage penalty for the anticipated difference in down time will be applied.

5. Main turbine-generator exciter will be driven off the main turbine-generator shaft with any boiler feed pump drive arrangements.

6. Fixed charges will be figured at a rate of 15%.

The basic thermal cycle selected has three low-pressure heaters, a deaerating heater, and four high-pressure heaters, all in series. Three half-size condensate pumps, taking suction from the condenser hotwell, will discharge through the low-pressure heaters to the deaerating heater. The boiler feed pumps will take their suction from the deaerating heater and discharge through the four high-pressure heaters to the steam generator.

With motor-driven boiler feed pumps in the preferred location at the basement level, booster pumps were not required with boiler feed pumps having speeds above 3,600 rpm.

Economics Determined Selection

The preferred location of the auxiliary steam turbine-driven boiler feed pumps was on the operating floor. The main turbine-generator, shaft-driven pumps would, due to turbine location, be at the operating floor level. With the latter two methods of drive, booster pumps would not be required with 3,600 rpm pumps, but would be required with higher speed pumps to insure having adequate net positive suction head.

As various combinations of boiler feed pumping equipment have proved reliable, a study was first made to determine the most economical combination with each of the three basic drives. These were then compared to arrive at a final selection.

A total of seven different arrangements of electric motor-driven boiler feed pumps were considered. These arrangements included half-size and one-third-size pumps; constant-speed and variable-speed equipment; 3,600-rpm and higher speed pumps; and, 3,600 and 1,800-rpm motors.

It was concluded that the most economical motor drive arrangement

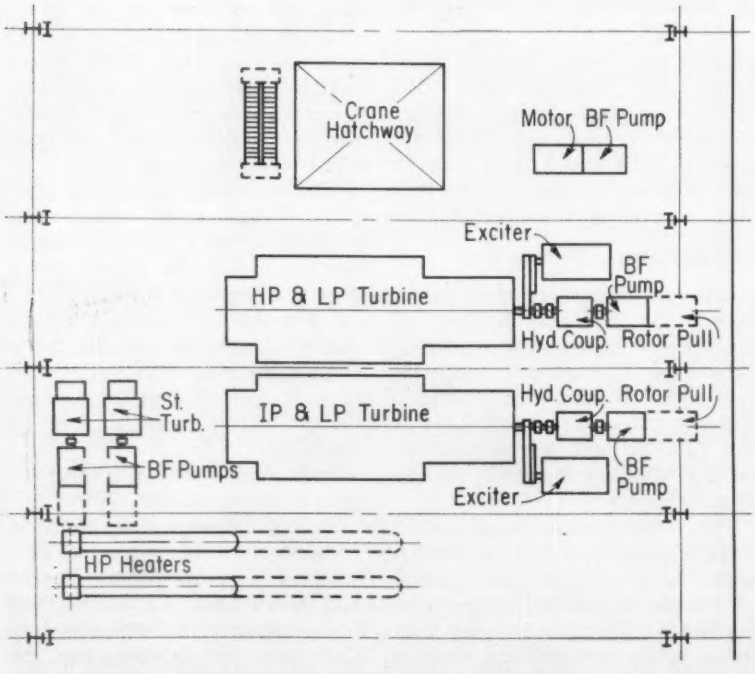


FIG 1—THREE BASIC ARRANGEMENTS of boiler feed pumps are shown in their relationship to the main turbine-generator unit on the operating floor of plant

BFP's Preferred Arrangement

would be with two one-half-size, 5,400-rpm, constant-speed pumps, each driven by an 1,800-rpm motor through a speed increaser.

Because of the proved reliability of boiler feed pumps, no spare pumps were considered necessary. To minimize the duration of possible forced outages, a spare inner pump assembly and a spare motor were included in the cost comparison.

A full-size, motor-driven pump was not considered, due principally to the heavy burden it would impose upon the auxiliary power supply system, especially during startup.

With constant speed pumps, the power waste due to throttling can be reduced by dividing the full capacity among two or more pumps. Furthermore, the more pumps installed, the less the loss of load when one pump is forced from service. Accordingly, two one-half size vs three one-third size pumps were considered. A cost study indicated that the two one-half size pumps with a spare inner assembly and a spare motor would represent the more economical investment, although not by a wide margin.

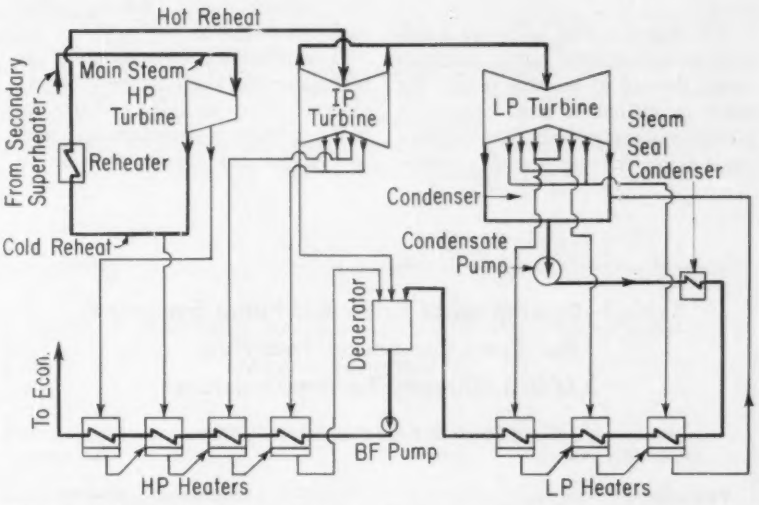


FIG 2—MOTOR-DRIVEN and main turbine-generator shaft driven boiler feed pumps bring about the identical heat cycle diagrams for the turbine-generator

Pump Types Compared

A comparison of variable-speed vs constant-speed pumps in the 3,600-rpm class indicated that the added cost of a variable-speed coupling could not be justified by the moderate savings in power because one-pump operation will be used when load drops below 60% of turbine-generator capacity for extended periods.

The higher than 3,600-rpm speed pump driven by an 1,800-rpm motor through a speed increaser was selected because of its lower combined equipment cost compared to the 3,600-rpm pump driven by a 3,600-rpm motor.

Condensing and noncondensing boiler feed pump auxiliary turbine drives were examined. As the main turbine will be of the 3,600-rpm, cross-compound, four-flow type with 26-in. last stage buckets, exhaust losses when operating between the expected 1 and 1.5-in. Hg back pressure will not be high. Consequently, the condensing turbine drive would not improve cycle efficiency enough to offset its higher cost.

With the auxiliary turbine drive, an electric motor-driven boiler feed pump is required during the start-up period when steam is not available to run the auxiliary turbine. While not considered a spare, the start-up pump may be used in an emergency outage of an auxiliary turbine-driven pump. As the probability of forced outages due to loss of a full-size pump did exist, a one-half-size, motor-driven start-up pump was included to minimize the probable forced outage cost.

Loss of one half-size pump would only reduce the load to two-thirds of full load, plus the added load contributed by the electric motor-driven, start-up pump if it is put

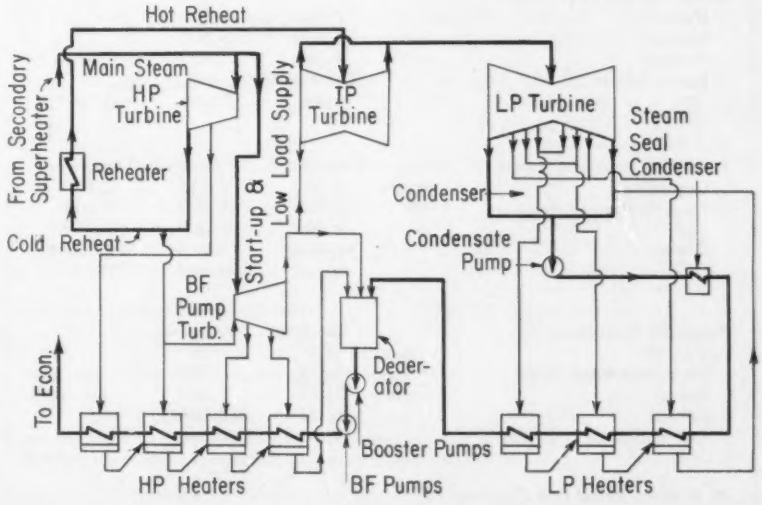


FIG 3—STEAM and condensate cycle for auxiliary turbine drive arrangement has heat cycle differing from that of motor or main turbogenerator drive

into operation. In this instance, a one-sixth-size, full-pressure start-up pump, rather than a half-size pump, was included to minimize the investment.

The full-size and half-size auxiliary turbine-driven pump arrangements proved to be very nearly the same in evaluated cost because a greater outage penalty was applied against the full-size pump arrangement. The arrangement with two one-half-size, auxiliary turbine-driven boiler feed pumps was selected for further comparison with the arrangements having other methods of drive.

Ten different arrangements of turbine-generator shaft drives were considered. They included full-size and half-size pumps, constant and variable-speed equipment, and 3,600-rpm and higher speed pumps.

It was concluded that the most flexible and economical shaft drive arrangement would be with two one-half-size, 3,600-rpm pumps, each driven through a fluid coupling.

The 3,600/3,600-rpm, cross-compound unit permitted the consideration of one full-size vs two half-size pumps. The half-size pumps provide an advantage of power savings compared to the full size pump at less than two-thirds load, with one pump only in service, should the unit be operated at light loads for long periods during the night or weekends. Moreover, complete loss of load with half-size pumps is less likely. The two half-size pumps were selected.

Table I—Description of Drive and Pump Equipment For Cross-Compound Four-Flow, 3,600/3,600-rpm Turbine-Generator

(Using Steam at 2,400 Psig, 1,050F/1,000F)

Pump Drive Arrangement		Main T-G Shaft	Auxiliary Turbine	Motor-1,800 rpm
Main Unit Rating:				
Turbine	—kw	265,000	258,000	265,000
Generator	—kva	312,000	312,000	320,000
Auxiliary Turbine:				
Source of Steam		.....	Cold Reheat	.....
Pressure & Temperature		.....	550 psig-650F	.....
Exhaust of Turbine to:		.....	Deaerator	.....
No. of Uncontrolled Extractions		.....	2	.....
Rated Hp		.....	5,300	.....
Rated Speed	—rpm	.....	6,400	.....
Motors for Main Unit Pumps:				
Hp		.....	.....	4,500
Speed	—rpm	.....	.....	1,800
Voltage	—V	.....	.....	4,160
Power Source		.....	.....	Aux Power Transf.
Motors for Start-Up Pump:				
Hp		2,000	2,000	.....
Speed	—rpm	3,600	3,600	.....
Voltage	—V	4,160	4,160	.....
Power Source		Cranking Transf.	Cranking Transf.	.....
Pumps for Main Unit Pumps:		2 Required	2 Required	2 Required
Capacity	—gpm	2,100	2,150	2,100
Total Developed Head	—ft	6,950	7,000	7,000
Speed	—rpm	3,500	6,400	5,400
Control		Variable Speed	Variable Speed	Regulating Valve
Pumps for Start-Up Pump:		1 Required	1 Required	.....
Capacity	—gpm	700	700	.....
Total Developed Head	—ft	7,000	7,050	.....
Speed	—rpm	3,570	3,570	.....
Control		Regulating Valve	Regulating Valve	.....
% of Max. Rated Unit Capacity with Largest Pump Out		83	83	67

Need Torque Limits

All shaft drive arrangements require a way of limiting the torque that can be imposed on the turbine-generator shaft in the event of pump seizure. Constant-speed arrangements included a clutch with a shear coupling to limit the torque; variable-speed arrangements included a fluid coupling with its inherent slip characteristic to limit the torque. Although the fluid coupling added substantially to the investment, its cost was very nearly offset by the cost of the clutch, feed-water regulating valve, and associated piping. Evaluation of the power requirements to drive the constant-speed and the variable-speed pumps showed, with the predicted capacity factors, a decided reduction in energy cost for the variable-speed pump. Because of the greater flexibility and the lower evaluated comparative cost, the fluid coupling was selected for the shaft-drive arrangement.

On the basis of a comparison of 3,600-rpm vs higher speed pumps, the 3,600-rpm pump was selected. The lower cost of the higher speed pump and the speed increaser combination was offset by the cost of a booster pump needed with the higher speed pump. The savings which applied in the case of electric motor-driven pumps, when 1,800-rpm motors could be used with high speed pumps, are not applicable with turbine-generator shaft drives.

The shaft drive arrangements with the two one-half-size pumps included a one-sixth-size full pressure start-up pump.

The three selected boiler feed pump arrangements, each with a different method of drive, were next compared. Table I shows the variations in the basic specifications for the turbine-generator and associated pumping equipment on the basis that the net kw capability of the turbine-generator would be the same with all three boiler feed pump drive arrangements. Keeping the net capabilities the same required a minimum of major power cycle equipment changes and, therefore, the comparison of the boiler feed pump drive arrangements was greatly facilitated.

Heat-cycle diagrams for the electric motor-driven and the turbine-generator-shaft-driven pump arrangements are identical. But the turbine-generator drive arrangement would permit a smaller generator and a smaller auxiliary power transformer by the amount of the pump power.

Capacity Identical

The balance of the cycle equipment, such as the turbine, condenser, steam generator, and feedwater heaters, would, for all practical purposes, have identical capacity. The turbine-generator drive arrangement requires shaft extensions, fluid couplings, and a start-up, motor-driven pump not required with the electric motor drive arrangement.

On the other hand, the motor drive arrangement requires motors, circuits, and controls not needed by the turbine-generator drive or auxiliary turbine drive arrangements, except for the start-up pump.

The heat cycle for the auxiliary turbine drive is shown in Fig 3. Compared to the electric motor-driven pump arrangement, the auxiliary turbine drive arrangement would permit a smaller main turbine, generator, and auxiliary power transformer by the amount of boiler feed pump power. The total initial steam flow from the steam generator would increase a little, but the reheater steam flow would decrease. The total heat input, however, would remain about the same. The condenser would be the same and so would the feedwater heaters, except for moderate changes in bleed steam conditions. The added equipment would be the auxiliary turbine drives, associated steam supply and exhaust piping, and start-up, motor-driven pump. This method of drive would not require main boiler feed pump motors, circuits, and controls.

Table II shows the equipment costs, excess cost differences, and penalty cost differences of the selected drive arrangements. From this table it can be seen that the main turbine-generator shaft drive arrangement is obtainable at a cost reduction of $229,500, compared to the motor-driven arrangement and at a cost reduction of $178,000, compared to the auxiliary turbine drive arrangement. Also, the shaft driven variable-speed pump arrangements, unlike the motor-driven variable-speed pump arrangements, have no generator, transformer, and motor losses to add to the power requirement.

The main turbine-generator shaft drive arrangement was selected.

Table II—Economic Comparison of Boiler Feed Pump Drive Arrangements[1]

Pump Drive Arrangement	Main T-G Shaft	Auxiliary Turbine	Motor-1,800 Rpm
Main Pump Size, No. & Speed	1/2 Cap. 2 at 3,600	1/2 Cap. 2 at 6,400	1/2 Cap. 2 at 5,400
Start-Up Pump Size, No. & Speed	1/6 Cap. 1 at 3,600	1/6 Cap. 1 at 3,600	Not Required
Cost Comparison			
A. Equipment Costs			
Main Pumps & Accessories	$159,500	$127,500	$178,000
Main Pump Spare Assembly	34,500	28,500	28,500
Start-Up Pump & Accessories	82,500	82,500	0
Variable Speed Couplings	90,000	0	0
Auxiliary Turbines & Accessories	0	450,000	0
Motors—Main Pumps	0	0	290,000
Motors—Start-Up Pump	52,000	52,000	0
Turbine-Generator Cost Difference	200,000	0	200,000
Total Equipment Costs	$618,500	$740,500	$696,500
B. Excess Cost Differences			
Building, Foundations, Mat. & Labor	$46,000	$7,000	$3,000
Piping, Valves & Controls, Mat. & Labor	4,500	20,500	0
Accessory Electric, Mat. & Labor	14,500	0	97,000
Total Excess Cost Differences	$65,000	$27,500	$100,000
C. Penalty Differences[2]			
Maintenance	$3,500	$14,000	$500
Forced Outage	0	0	5,500
Performance	0	83,000	114,000
Total Penalty Differences	$3,500	$97,000	$120,000
A. Total Equipment Costs	$618,500	$740,500	$696,500
B. Total Excess Differences	65,000	27,500	100,000
C. Total Penalty Differences	3,500	97,000	120,000
Total Comparative Cost (A+B+C)	$687,000	$865,000	$916,500

[1] Most economical arrangement of each drive type determined from individual comparisons.

[2] Annual penalties capitalized at 15%, based on fuel cost of 40¢ per million Btu for first year and increasing at rate of 2% per year.

Capacity Factor: An average unit capacity factor of 0.63 for 35-year life.

AREA OFFICE in Hydro-Electric Power Commission of Ontario system has Monroe autopunch shown in operation

REGIONAL OFFICE personnel operate automatic area selecting equipment, shown here between Lorenz machines

Teletype, EDP Speed Accounting,

Network of leased lines transmits higher-quality data from area to head office; centralized accounting reduces costs

F. P. THOMAS, Director of Data Processing, Hydro-Electric Power Commission of Ontario, Canada

■ Centralized electronic accounting of about 500,000 rural accounts, using a large-scale digital computer and a province-wide communications network, is moving on schedule at Hydro-Electric Power Commission of Ontario. This ambitious approach marks the first matching of the capabilities of a large-scale computer with teletype service over telegraph and telephone facilities that interlace the utility's territory. Experience with the combination points to an on-time realization of these objectives:

1. Significant improvement in the quality and speed of obtaining data needed not only for customer billing but also for management control.

2. Cost reduction in the accounting operation through eventual elimination of clerical jobs, less manual handling of data, and the return of numerous business machines.

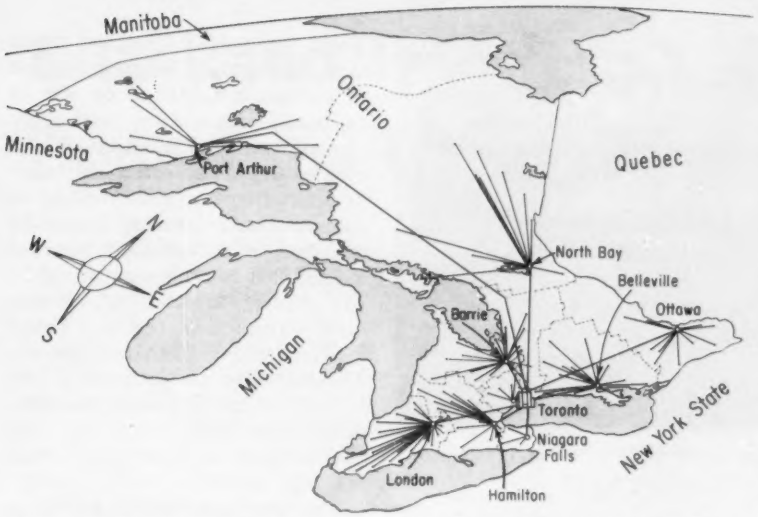
3. Savings of several hundred thousand dollars annually in the customer accounting operation.

Planning for and installing the computer, a Remington-Rand Univac II, and setting up the teletype service was Project One at Ontario Hydro. This phase includes all aspects of customer accounts and statistics, including billing and demand load reports. It was completed last year. Now underway at Ontario Hydro are the second and third phases: Project Two—manpower, including payroll, labor statistics and personnel records; Project Three—materials, including inventory control. Ontario Hydro confidently expects to see completion of these two projects sometime in 1963.

Early last year, customers of Ontario Hydro received their first bills produced by the large-scale electronic data processing system. The bills were the culmination of three years of intensive planning and reorganization. The story of this planning and reorganization illustrates the amount of integration that can be achieved with today's versatile electronic equipment.

Show Problem's Scope

A few statistics will illustrate the scope of the problem at Ontario Hydro: The utility serves over 500,000 retail customers throughout the province of Ontario, plus about 600 industrial and large wholesale customers. Directly and indirectly it serves about 1,800,000 consumers. It has 15,800 employees, 17,700 circuit miles of transmission lines, and 47,300 miles of rural distribution lines. The utility operates 66 hydroelectric generating stations and two major thermal generating plants, and 124 transformer stations. In 1959 demand totaled 5,557,000 kw. From 1962 to 1980, annual load growth



MAP of Province of Ontario, Canada shows network of telephone lines employed to transmit data from area and regional offices to central office

Control Data

is expected to average 6%.

The administrative organization at Ontario Hydro is divided into nine geographical regions, each responsible for its own facilities (with over-all control of day-to-day power requirements centered in the Toronto head office). Each region is sub-divided into areas, the number of areas per region ranging from four to 20. There are altogether 103 areas, each with an office, a manager and staff. It is the responsibility of the area manager to provide and maintain distribution facilities, to attend to the needs of customers and to administer their accounts. It might be noted that final payment and cut-off notices addressed to the customer are mailed to the area office for distribution.

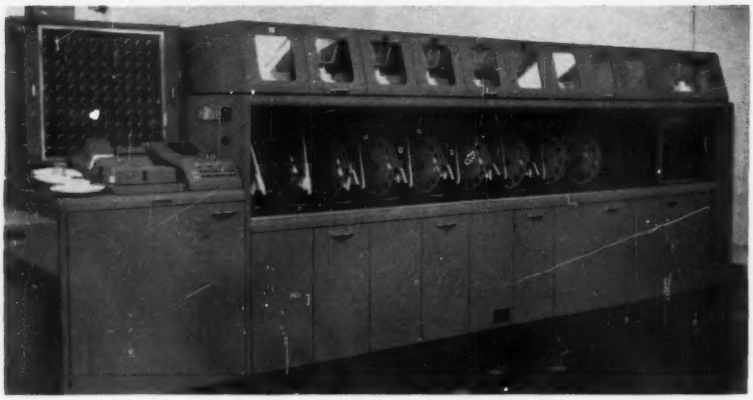
When information for billing and management control has to be handled over so broad a network and through diverse levels of control, it is impossible to avoid duplication, delay and error. And despite the widespread use of electro-mechanical business machines, a considerable amount of data still had to be handled manually prior to the installation of the computer. This called for a large staff and compounded opportunities for human error.

In setting up its large-scale electronic data processing (EDP) system, Ontario Hydro's first objective was to improve the quality of the information needed for control. Speed, accuracy and economy were the vital requirements. And while EDP was clearly seen as the solution, it was realized from the first that full integration would take several years to achieve. Plans for an integrated EDP system for the wide range of operations at Ontario Hydro began as early as 1950, but moved slowly pending development of high-speed input-output equipment. With the development by Sperry Rand, IBM and others of such equipment in 1954, Ontario Hydro allocated staff to full-time learning in the field of automated data processing.

The next year saw the beginning of a full-scale feasibility study in collaboration with five major manufacturers of electronic computers. Their machines were analyzed by a point-weighting technique applied to 140 machine characteristics.

By August, 1956, the feasibility study group had estimated the cost and effect of an integrated EDP system for the whole of Ontario Hydro. The study covered the first three functional areas: customers, manpower and materials. It was then decided to establish such a

HEAD OFFICE of Ontario Hydro in Toronto is equipped with page printers and reperforators which automatically receive and record from outside data



PUNCHED TAPE runs through this high-speed identifier-sorter-reperforator unit which is tied in directly with the extensive telephone system network of lines

CLOSEUP of the equipment shown above dramatizes the input device and the controls on the identifier-sorter-reperforator unit in the Toronto headquarters

system based on a Univac II; to create a data processing division; and to use a wire communications system.

Significant factors which led to the choice in 1956 of a Univac II were (1) Input and output speeds of up to 25,000 characters per sec; (2) agreement by Remington Rand Ltd, Canadian subsidiary of Sperry Rand, to include in its Toronto service center a duplication of all equipment leased by Remington Rand to Ontario; and (3) availability to Ontario Hydro of first call on this corresponding equipment in the event of a breakdown. Use of a teletype communications network was a natural choice because of the availability of facilities and the cost. It was primarily a matter of leasing facilities from two communications companies, Canadian National Telegraphs and Bell Telephone Co of Canada.

Since October, 1956, what has been accomplished? The entire data communications system has been set up and is being used currently for billing customers. Each area office is equipped with modified dual-register autopunch machines made by Monroe Calculating Machine Co of Canada. These produce a punched paper tape and a plain language version of the relevant data to be sent to regional offices and the head office.

The paper tape is put into a teletype transmitter which is automatically triggered into action by an automatic area selector (especially designed by Canadian National Telegraphs) in each regional office. The selector "searches" all the area lines within one region. Transmission rate is 6 characters per sec. The messages are received in the regional offices on Lorenz machines, which reproduce not only the original paper tapes but also a plain language version.

The new tape is transmitted to the head office at 7½ characters per sec through Bell Telephone facilities. These include the regional transmitters, region-to-head office lines, model 28 page printers and receive-only typing reperforators in the head office, one for each of the nine regional offices. The mass of incoming data is handled by a unique identifier-sorter-perforator unit. This identifies the codes denoting the various kinds of messages and consolidates, on separate reels, all messages of the same type. It works at 60 characters per sec.

Data Placed at Magnetic Tape

At this stage, the input data is still on paper tape (standard teletype five-channel code). Before any further processing it is converted to the seven-channel magnetic tape used by the computer. Electronic equipment for conversion, for computation and for printing is part of the main computer system. Peripheral equipment includes the paper tape-to-magnetic tape converter (converting up to 240 characters per sec), 12 uniservos, two 10-line-per-sec high speed printers and six unitypers. Four verifiers also have been added.

Finally, equipment in the data processing division includes a unique machine developed by Moore Business Forms to glue, fold and burst the sprocket-fed perforated paper (up to card stock) used by the high speed printers. It can also sign payroll checks.

Training of personnel began in 1958. Staff now numbers about 90, almost all of whom formerly worked elsewhere in Ontario Hydro. Staff

(*Continued on page* 42)

Dual-Ratio Transformer Savings Depend on Load Growth

W. E. MEKOLITES, Distribution Engineering Div, American Electric Power Service Corp, New York, N. Y.

Only the savings in labor costs resulting from simplifying the mechanics of voltage conversions can justify the higher initial investment of dual-ratio distribution transformers. Because the additional carrying charges reflecting the 12 to 14% premium for these transformers is carried every year over their life, dual-ratio transformers will be economical only where load growth justifies early changeout to larger conventional transformers after the conversion. Unless changeout of the dual-ratio transformers and re-use in another projected conversion area comes within four to seven years, depending upon their ratings, the additional carrying charges will exceed any possible savings due to expediting the conversion.

Table I—Dual-Ratio Transformers Save Conversion Labor

	10 kva	25 kva	50 kva
Case I —Routine changeouts of areas for future conversion	$48.55	$72.30	$92.50
Case II —As preparatory step prior to conversion	22.30	32.85	40.35
Case III—As preparatory step where alternative locations are available	4.95	5.10	4.10

Changeout Frequency Critical

Economical loading practice for residential area distribution transformers on the American Electric Power System dictates an initial load of about 95% of nameplate and changeout at 145%. If transformers are loaded in this range, the load growth rate must be 10% or greater for the transformer to be changed in four years. Even if areas are experiencing 10% load growth, a good portion of the increase results from new transformers serving new customers. This means, of course, that existing transformers are experiencing somewhat below 10% growth. Thus the changeout rates needed for economical use of dual-ratio transformers would, in most cases, be too frequent to provide economical operation of the distribution system.

These conclusions stem from an analysis of the use of 2,400 × 7,200-120/240-v transformers on a 2,400/4,160-v system which is scheduled for conversion to 7,200/12,470-v operation. For such a situation, the externally-operated

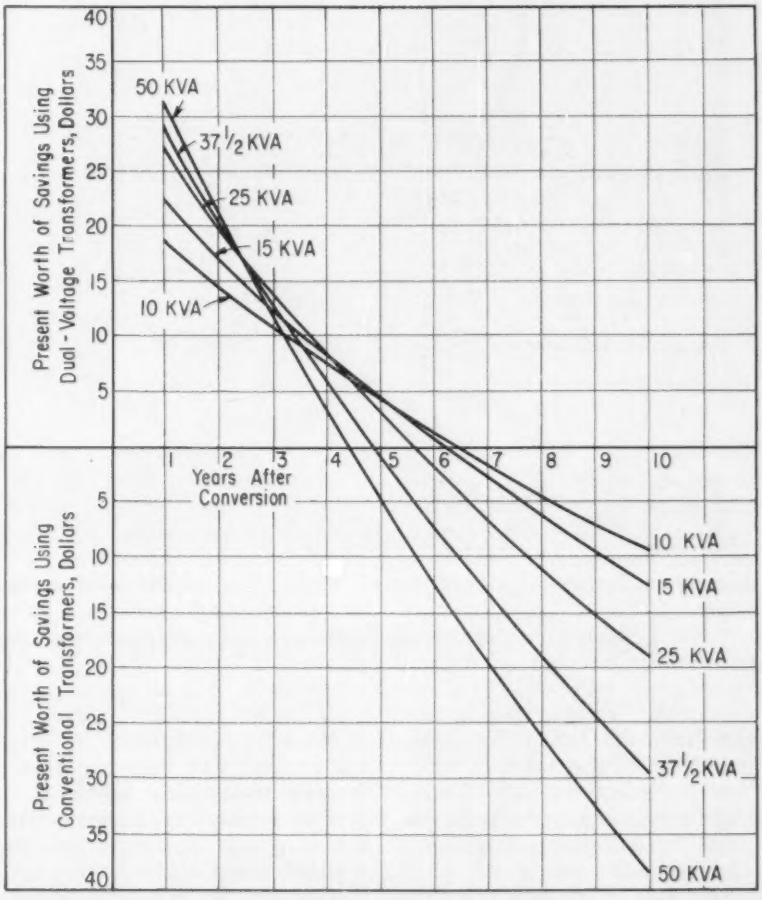


FIG 1—Time before next changeout is key to savings when dual-ratio transformers are installed as first step in converting 4-kv distribution area to 12.47-kv

Table II—Dual-ratio Transformers Must Be Changed Out Periodically to Break Even

Year	Additional Cost of 25-kva Dual Ratio . . . Carrying Charges at 17.5% on $40.43*	Present Worth of Carrying Charges	Conversion Savings . . . Labor	Present Worth of Labor Savings
0	.....	.....	$32.85	$32.85
1	$7.07	$6.65		
2	7.07	6.29		
3	7.07	5.94		
4	7.07	5.59		
5	7.07	5.30		
6	7.07	4.95	32.85	22.99
7	7.07	4.74		
8	7.07	4.45		
9	7.07	4.17		
10	7.07	3.96		
11	7.07	3.75		
12	7.07	3.54	32.85	16.42
13	7.07	3.32		
14	7.07	3.11		
15	7.07	2.97		
16	7.07	2.75		
17	7.07	2.61		
18	7.07	2.47	32.85	11.50
19	7.07	2.33		
20	7.07	2.19		
21	7.07	2.05		
22	7.07	1.98		
23	7.07	1.84		
24	7.07	1.77	32.85	8.21
25	7.07	1.62		
26	7.07	1.55		
27	7.07	1.48		
28	7.07	1.41		
29	7.07	1.27		
30	7.07	1.20	32.85	5.58
31	7.07	1.13		
32	7.07	1.06		
33	7.07	1.06		
Total present worth		$100.50		$97.55

* Additional cost over conventional unit = $40.43

series-parallel switch of the dual-ratio transformer facilitates the conversion and minimizes the customer interruptions required. Such transformers can be used in either of two ways:

1. As a standard policy for all transformers installed or replaced in an area designated for future conversion, thus providing in these new units the facility to convert quickly to the new voltage.

2. Replacing existing 2,400-v transformers in an area being prepared for immediate conversion to 12.47-kv so that linemen will simply change taps during a short conversion outage.

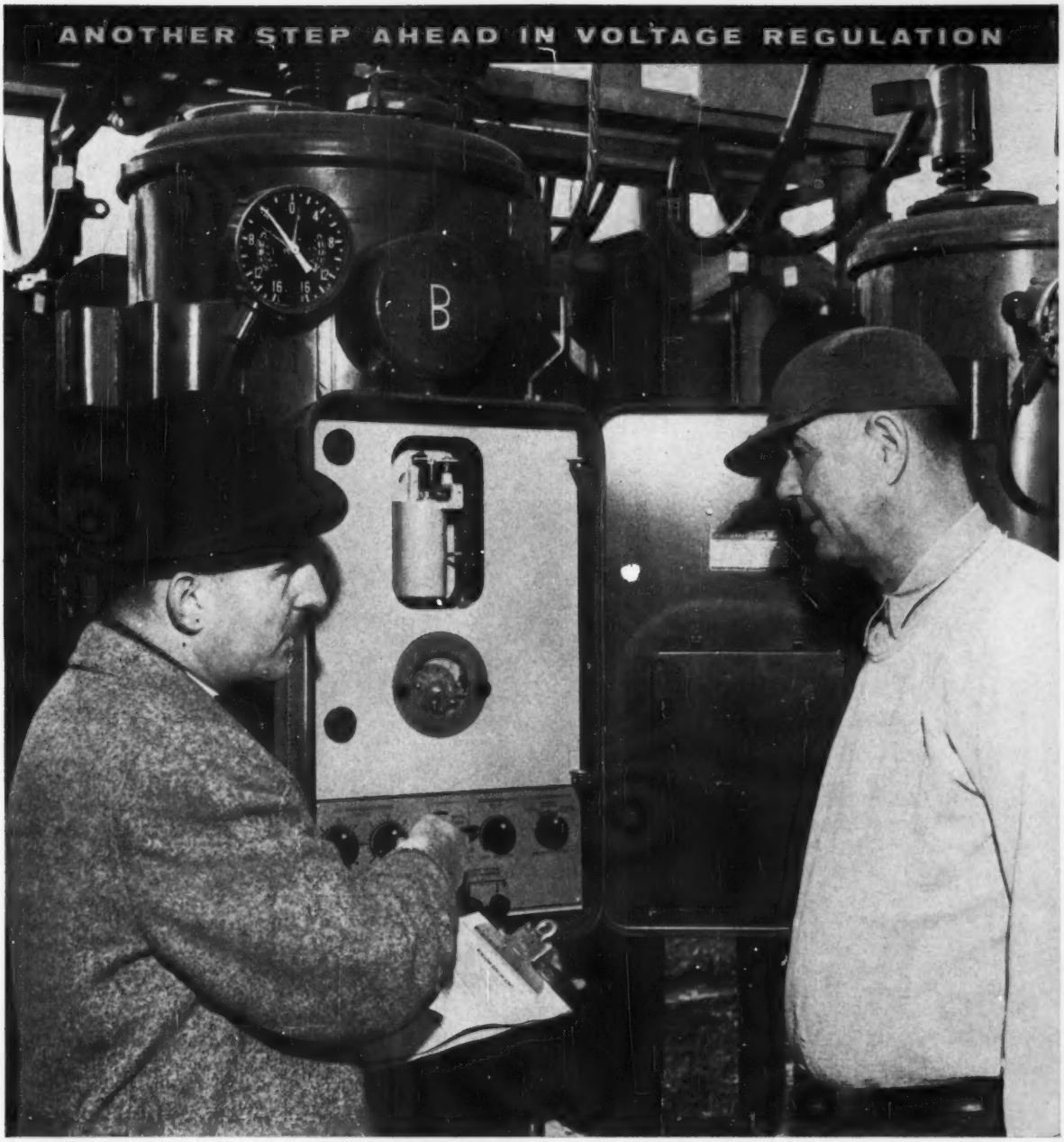
Labor costs to change distribution transformers from 4.16-kv service to 12.47, where dual-ratio transformers are installed as a matter of policy, are evaluated in Case I. Certain steps which are common to conventional and dual-ratio transformers are dropped from the comparison, leaving only those costs which differ. The savings in labor costs are substantial.

The other alternative of replacing conventional with dual-ratio transformers immediately before conversion merely to facilitate the actual voltage change saves considerably less (Case II). And where 7,200-v transformers can be installed in advance on different poles from the 2,400-v transformers (Case III), the labor savings almost disappear.

Such comparisons are not complete, however, without consideration of the 12 to 14% additional cost of dual-ratio over conventional transformers. This increment is $40.43 for a 25-kva unit and ranges upward to $61.42 for a 50-kva. The carrying charge on this incremental cost at 17.5% is $7.07 per year for a 25-kva transformer and $10.75 for a 50. And the present worth of these incremental costs for the assumed 33-year life of the transformer is $100.50 for a 25-kva, and $152.97 for a 50-kva.

These costs are spread over the

(*Continued on page* 40)



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Dual-Ratio Transformer Savings (*Continued from page* 38)

Table III—Dual-ratio 25-kva Transformer Offers Conversion Savings with Routine Changeouts

Dual-Ratio Transformer . . .					Conventional Transformer . . .				
Year	Step	Carrying Charges	Excess Losses over 2.4-kv unit	Present Worth	Step	Carrying Charges 2,400-v Unit	Carrying Charges 7,200-v Unit	Excess Non-recurring Labor	Present Worth
0	Install				Install 2,400-v unit				
1		$67.28	$3.33	$66.61		$56.90			$53.68
2	Convert	67.28	3.33	62.84	Repl. with 7,200-v unit	56.90		$72.30	114.99
3		67.28		56.49			$60.20		50.54
4		67.28		53.29			60.20		47.68
5		67.28		50.28			60.20		44.98
6		67.28		47.43			60.20		42.44
7		67.28		44.75			60.20		40.04
8		67.28		42.21			60.20		37.77
9		67.28		39.82			60.20		35.63
10	Changeout	67.28		37.57	Changeout		60.20		33.61
Total present worth				$501.29					$501.36

number of locations where each transformer is used during its assumed 33-year life span. Each such installation presumably will save some conversion labor, so the present worth of these savings must be credited. The relatively simple situation where a 25-kva dual-ratio transformer is installed immediately before conversion (Case II) must be repeated at intervals of less than six years before the $32.85 savings in labor each time will add to a present worth value greater than $100.50 (See Table II). Changeout time must be cut to four years for a 50-kva and may be increased to six years for a 10-kva dual-ratio transformer (See Fig. 1). Savings occur only when changeout times are shorter than these breakeven values, and such rapid changeout of transformers is rarely justified.

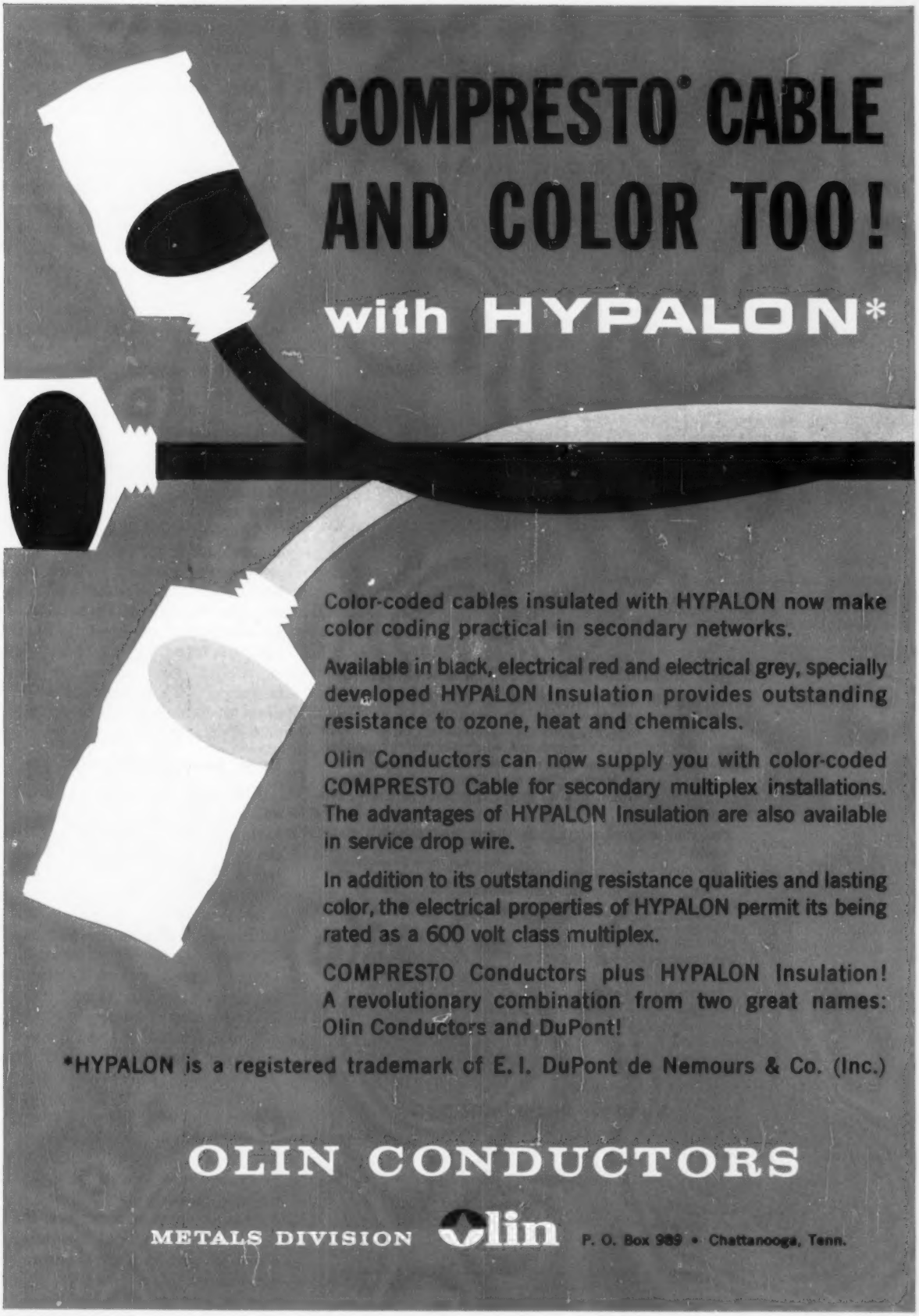
Installation of dual-ratio transformers during routine changeouts in a 4.16-kv area scheduled for future conversion (Case I) gives the most favorable opportunity for savings. In such cases the dual-ratio transformers are installed with the same labor that would have installed 2,400-v units, thereby minimizing conversion costs. But part of this savings must be charged off against increased carrying charges and greater losses in transformers built for 7,200-v and operated at 2,400-v. Thus the period of operation at 4.16-kv introduces another variable in the analysis. If a 25-kva dual-ratio transformer is installed two years before conversion and remains in service ten years before changeout, the present worth of its carrying charges, incremental losses, and non-recurring labor costs is equal to the present worth using conventional transformers. (Table III). If actual conversion comes more than two years after installation, a conventional unit shows economic advantage.

A 50-kva dual-ratio unit installed two years before conversion (Table IV) would have to be changed out in eight years to break even. A reduction of the time in service at 2,400-v before conversion will boost the savings in favor of dual-ratio, provided the transformer can be re-installed promptly in another area to aid conversion.

Dual-ratio transformers are economical only in a very limited range and are certainly controlled by load growth causing change-out, making them available for future conversions. Proper initial loading of transformers, changed in a cutover, indicate dual-ratio transformers can seldom be applied economically.

Table IV—Changeout Rate Sets Economic Limit To Routine Installation of Dual Ratio Transformers Prior to Area Conversion

When load growth requires change-out every	12 yrs	10 yrs	8 yrs	6 yrs
The economic max. years before conversion is:				
for 10-kva units	2	3	4	5
for 25-kva units	1	2	3	4
for 50-kva units	0	1	2	3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Installation of 60-PCL-23 C&D PlastiCal® Control Battery at new 75,000 kw Harbor Station, United Illuminating Co., Bridgeport, Conn.

United Illuminating Co. uses C & D PlastiCal® batteries for the critical job of control

By any check—capacity, convenience, economy, life—C & D PlastiCal® batteries can't be matched, when it comes to supplying instantaneous, dependable power for critical control applications.

Here at the new Harbor Station of The United Illuminating Co., Bridgeport, Conn., C & D PlastiCal control batteries have four important jobs:

1. operating control relays, pilot lights, and signals on the control board;
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(*Continued from page* 36)

selection began with advertising, both internally and publicly. This produced some 600 applicants. Separate groups have been trained over four-month courses. The fifth of these courses is now in progress.

To carry out Project One, graduates of the first course formed teams to examine the requirements of the customer system. Some idea of the extent of this survey can be judged from the fact that it produced 703 flow charts, 865 forms used in directing operations, 900 pages of written descriptions and 2,300 descriptions of forms used. However, the object was not to produce a record volume of paper; volume resulted from the fact that every regional and area office was visited. The survey was completed in October, 1957; by March, 1958, the final version has been settled.

Sample testing, using 4,000 customers' accounts, extended over a one-month period, followed by four months of parallel operation involving some 30,000 customers in one region. In April, 1959, the bills produced by electronic data processing were mailed to these customers. Then followed a program of conversion, area by area, and region by region.

Large Savings Anticipated

Completion of all three projects will add up to this. Anticipated net savings, when all systems have been developed some three or four years hence, is estimated at several hundred thousand dollars. Cost reduction is envisaged through:

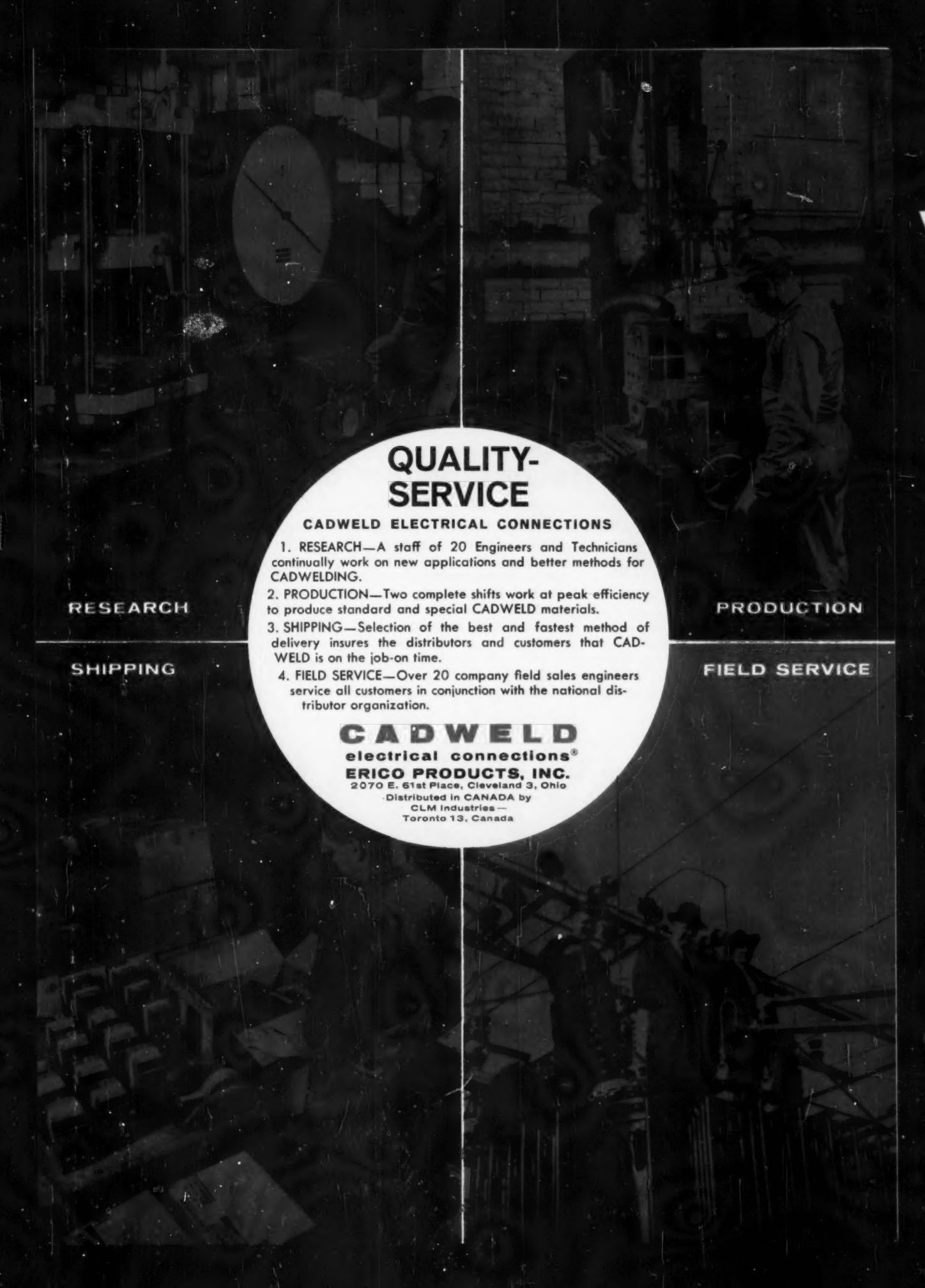
1. Eventual elimination of several hundred jobs (with elimination geared mainly to staff turnover spread over six years).

2. The return of numerous business machines (including a medium-scale computer used for engineering work).

3. Reduction of both error and duplication of effort caused by manual handling of data.

4. The availability in a shorter time of reports and forecasts, on which to base management decisions.

5. The solution of many new business, engineering and scientific problems beyond the scope of previously-used computation equipment.



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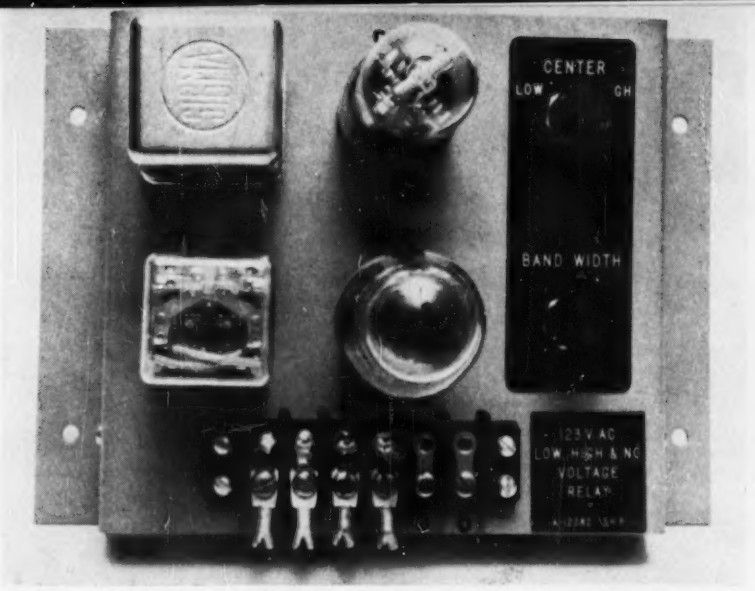
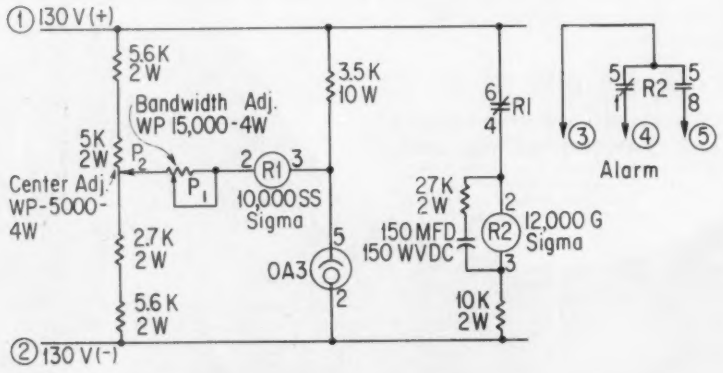


Hi-Lo Voltage Relay Monitors Battery Circuit

M. E. BYRNE, Protection Engineer,
J. N. HAROIAN, Protection Engineer,
C. A. DIFFENDAFFER, Relay Technician, Idaho Power Co, Boise, Ida.

A hi-lo voltage relay device provides Idaho Power Co with a high-voltage, low-voltage, and no-voltage alarm on substation battery circuits. The device is sufficiently rugged to withstand severe mistreatment and can be handled by relatively inexperienced installers.

Because of their proven reliability, gaseous regulator tubes are used in the device to establish the voltage reference. In the schematic diagram, P_2 is the voltage pickup (and dropout) adjustment, and P_1 is the bandwidth adjustment. Battery alarms (for a 60-cell battery, for example) were desired at 119-v low voltage and 146-v high voltage, which is a band width of 27 v and a midpoint of 132½ v. P_1 is adjusted for a 27-v band width and the center of the band is adjusted to 132½ v when P_2 and the relay are set. P_1 and P_2 are not independent, thus readjustment must be made before the desired setting is obtained.



Voltage Decreasing:

139-V	Relay R_1 drops out, R_2 picks up
119-V	Relay R_1 picks up, R_2 drops out, low-voltage alarm
77-V	OA3 out
15-V	R_2 drops out
4-V	R_1 drops out

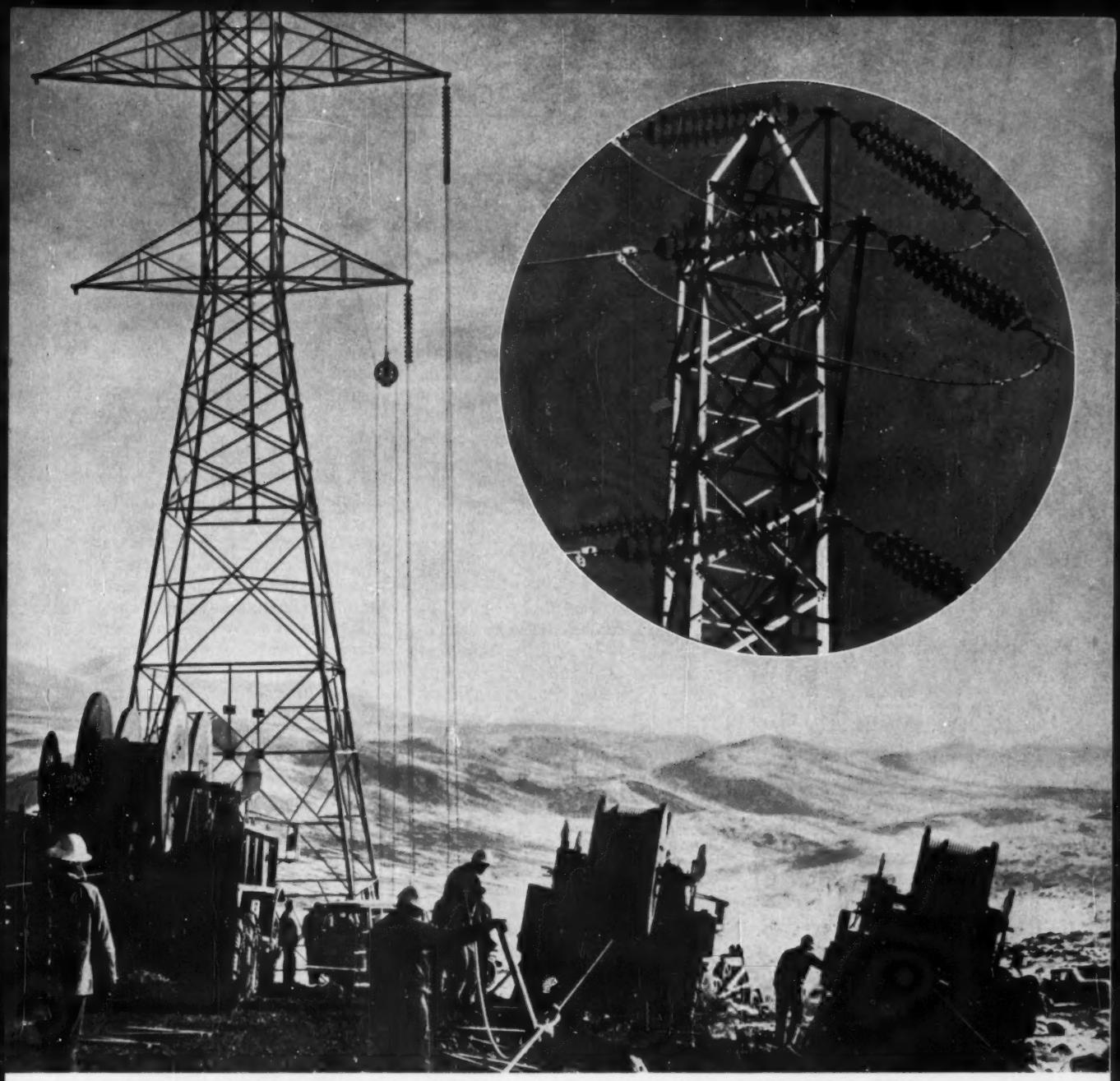
Voltage Increasing:

15-V	Relay R_1 picks up
105-V	OA3 fires
125-V	Relay R_1 drops out, R_2 picks up
146-V	Relay R_1 picks up, R_2 drops out, high-voltage alarm

The relay R_2 was installed to give an alarm when the voltage is zero. Actually, on a low voltage alarm, once R_1 is picked up, it will hold in even after the OA3 has ceased firing down to 4 v, then it will drop out. The relay R_2 was chosen so when the voltage goes down towards zero, it will drop out. This gives a no-voltage alarm. With the capacitor discharge circuit, a time delay of up to 15 sec is available.

On a typical setting, the relay has operating characteristics as described in box at left.

In testing, the hi-lo voltage relay had a temperature sensitivity of −2% and +1% of rated voltage at 66C and −20C, respectively.



Idaho Power's section of 230KV line from Oxbow to Lewiston, Idaho during construction. Insert shows completed tower.

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Where the terrain is rough . . . where insulator replacement is even rougher, VICTOR 10" Suspensions are the answer to continuity of service. Take Idaho Power's section of the Oxbow-Lewiston 230KV line shown under construction above. Located on the Snake River in the Hells Canyon area, this 66-mile line crosses one of the most inaccessible parts of the Northwest. Insulators are put up to stay up. Because of VICTOR Purified Porcelain, quality manufacturing control, and electrical and mechanical laboratory testing, they have proved their ability to far exceed their EEI-NEMA ratings. That means when you buy VICTOR Suspensions, you buy dependable, trouble-free service.

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Watt Transducer Operates on Hall Effect

JACK MEILI, Instrument Dept, Westinghouse Electric Corp, Newark, N. J.

Better basic knowledge and increased purification of intermetallic semiconductors permit the practical use of long-known galvanolectric effects, leading to many novel applications in equipment design. One such device, the Hall generator watt transducer, operates on the "Hall Effect" principle to convert a change in power input to a proportional change in dc millivolt output.

The watt transducer has two major advantages over other devices previously used to perform a similar function. First, its response time is a few microsec for the unfiltered unit. Second, it has comparatively high overload capacity, because there are no thermal elements.

The first advantage is important in applications involving computers, particularly in conjunction with automatic control. The virtually instantaneous response of watt transducers fulfills the basic requirement of having a single variable quantity (dc millivolts) proportional to electric power for use in systems designed for computer control, overcoming the slow response of thermal converters. Also, the watt transducer can provide an input to both the computer and a separate indicating instrument in most cases.

Fig 1 shows how the watt transducers are used for both telemetering and totalization. A separate transducer is used for each of three generators. Connection to the generator circuit is made through suitable current and potential transformers. The transducers are calibrated so that an output of one millivolt equals the same number of primary kw in each case. When these millivolt outputs are added in series, the total is proportional to total generator output. In the diagram, this millivolt output is applied to the input terminals of (1) a potentiometric recorder and (2) a telemetering transmitter. The recorder gives a local indication of total power output, while the transmitter codes the millivolt quantity and telemeters it to a remote location for display on properly calibrated end devices.

Such applications require transducer outputs which are relatively free from ac ripple, because the high impedance devices fed by the transducer have electronic components whose accuracy would be impaired if ripple were present. As the inherent response of the transducer is rapid, its fundamental output is a fluctuating quantity whose average dc value is proportional to average watts input. For use with high impedance devices, a conventional L-C filter is included in the transducer to suppress the ac ripple.

(*Continued on page* 47)

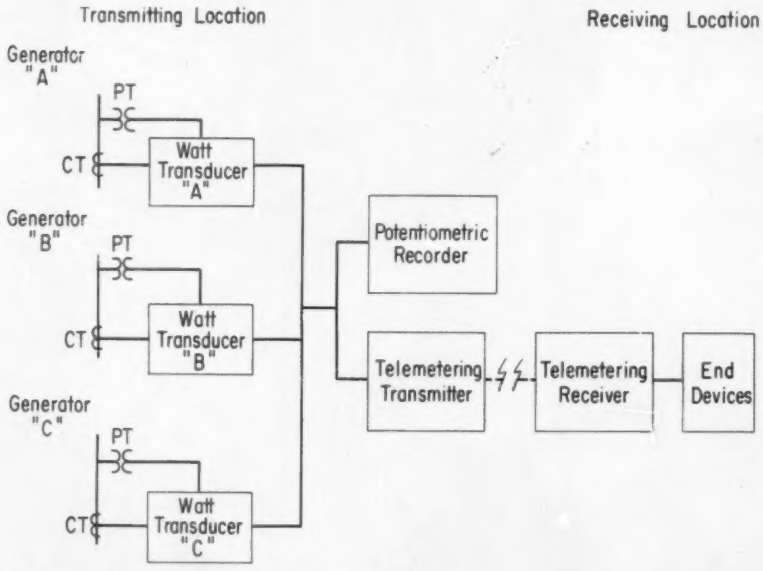
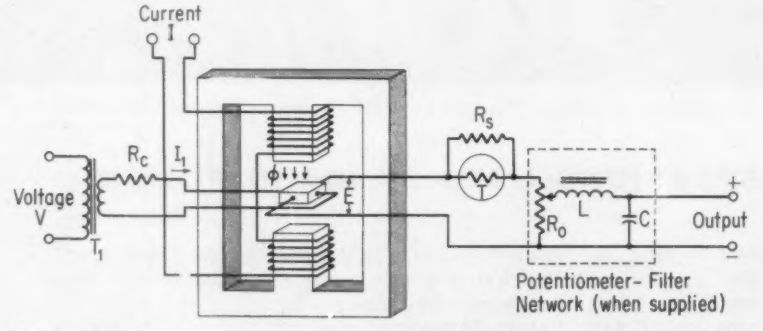


FIG 1—WATT TRANSDUCERS are used for both telemetering and totalization. When outputs are added in series, total is proportional to generator output



I=Line Current
V=Line Voltage
ϕ=Flux Caused by Line Current (I)
T_1=Voltage Circuit Step-Down Transformer
I_1=Voltage Circuit Current
R_C=Voltage Circuit Current Limiting Resistor
R_S & T=Temperature Compensating Network
R_O=Output Circuit Potentiometer
E=Hall Output Voltage
L,C=Filter Network Components

FIG 2—SINGLE ELEMENT TRANSDUCER is used for single-phase applications. A polyphase transducer has two similar elements with outputs in series

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Designed for Jobs Too Heavy for
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MINERALLAC

Watt Transducer

(*Continued from page* 46)

There are applications, however, where the unfiltered output can be used directly. One of these is the use of the transducer with a conventional dc instrument mechanism to indicate watts. This eliminates the complicated electrodynamometer instrument mechanism normally associated with wattmeters.

The Hall Effect states that "If a conductor carries a current at right angles to a magnetic field, a charge difference is generated on the surface of the conductor in a direction which is mutually perpendicular to both the field and the current." In Fig 2, this charge difference produces the output voltage "E," which is, therefore, proportional to input current "I," input voltage "V," and the phase angle between them. This, of course, equals input watts.

Fig 2 shows the circuit of a single-element transducer used for single-phase applications. A polyphase transducer would have two similar elements with their outputs added internally in series. The resultant output is then proportional to polyphase power.

In the construction of the transducer, the Hall crystal is potted inside the laminated core of the current circuit to insure firm positioning. A step-down transformer is included in the voltage circuit.

A polyphase transducer employs two watt elements and incorporates an L-C filter network. Each element is mounted on an individual aluminum plate, while the filter network and its associated adjustable output potentiometer are mounted on a third plate.

A resistance network employing a thermistor in parallel with a low temperature coefficient resistor is used to reduce the resistance of the circuit external to the crystal and thereby compensate for the low output voltage. With this circuit, the transducer can be used accurately from zero C to 65C.

Normal output from the transducer is 50 millivolts per element (100 millivolts for a polyphase unit). Standard input ratings are 5 amp and 120 v, although by changing the windings on the current coils, ratings from 50 milliamp to 10 amp can be

(*Continued on page* 66)

GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.

Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

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STEEL & WIRE CO., INC., Muncie, Indiana

ALLIS-CHALMERS

1. Core nests in base-plate sump.
3. Dropover tank design cuts untanking height and weight.
2. Heavy inside tank bracing eliminates outside stiffeners.
4. Captive-type handhole bolts. No small parts loss.

YOU BET IT'S DIFFERENT ...HERE'S WHY!

Allis-Chalmers engineers re-examined, then redesigned small power transformer mechanical features . . . all to *your* advantage! Check their latest achievements:

1. Easier to handle, move and install. Lower height, center of gravity and weight achieved through a unique base-plate sump that houses the lower section of the core.

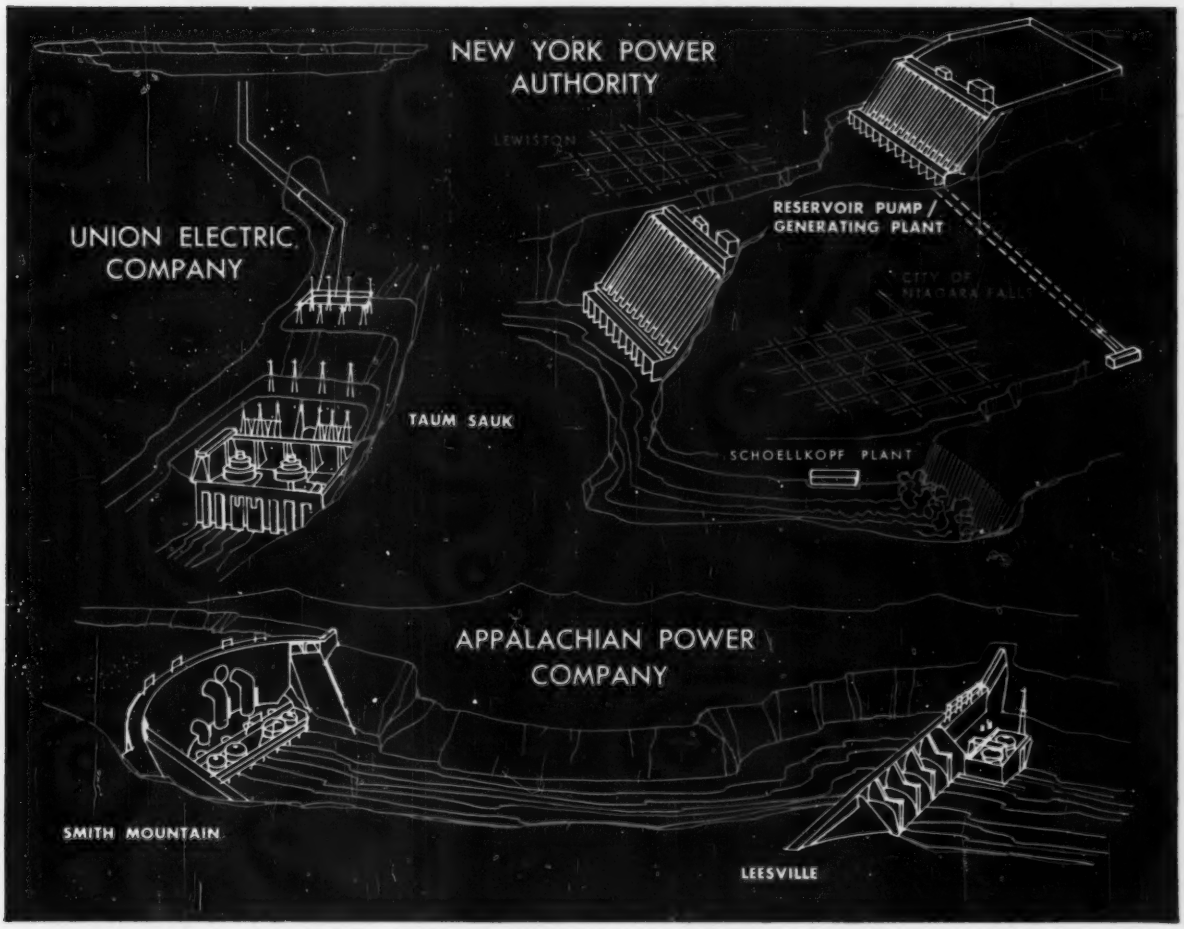
2. Repainting simpler — self-cleaning tank reduces maintenance. Internal tank wall bracing eliminates outside debris-catching, rust-prone tank channels.

3. Smaller untanking facilities required. Dropover tank reduces untanking height and weight 50%.

4. Internal inspection quicker and safer. No more dropping manhole cover nuts or bolts into the tank or onto the ground. Only five captive-type nuts and bolts need be loosened to remove cover. Excellent seal and reusability achieved through use of Buna-N gaskets.

Your nearby A-C office can furnish facts and Bulletin 61C6084B, or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1396

ALLIS-CHALMERS



Just what you'd expect from the pumped-storage pioneer:

first in all three

Pumped-storage power projects now under construction in this country all rely on Allis-Chalmers reversible pump-turbines. In fact, A-C is the only builder of complete reversible pump-turbine equipment!

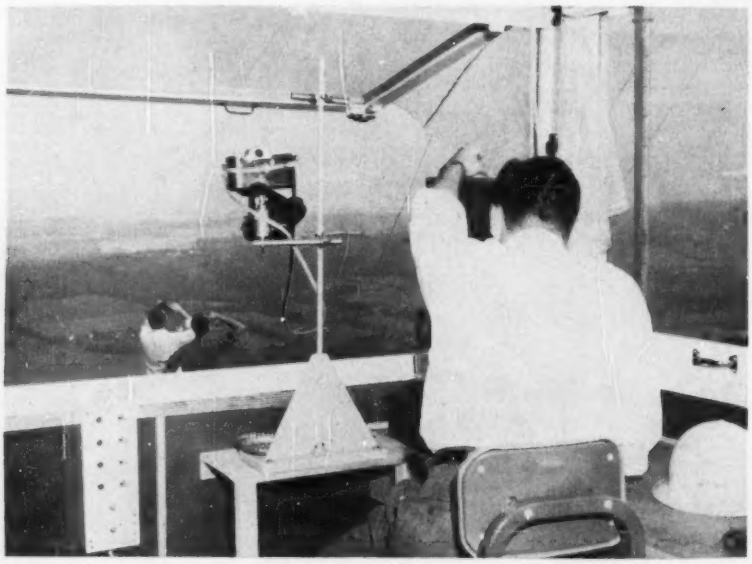
First in boosting existing hydro at Niagara Reservoir pump/generating plant! This pumped-storage project will capitalize on the hydro-electric power potential of Niagara River without adversely affecting the scenic beauty of the Falls. Largest project of its kind, this installation will include 12 reversible pump-turbines with motor-generators . . . all designed and fabricated by Allis-Chalmers. As a turbine, each unit is rated 28,000 hp under 75-ft net head; as a pump, 3,400 cfs at 85-ft total head.

First in pure regeneration — at Taum Sauk! . . . also to have the largest-capacity hydro units ever built. Allis-Chalmers will supply two 175,000 kw reversible pump-turbines, each with a capability exceeding 300,000 hp under 800-ft head. (Pure regeneration installations need only a water supply to replace evaporative losses, so a creek is ample. Even a hill is unnecessary: the pool can be underground, in an abandoned mine shaft, for example.)

First in run-of-river — at Smith Mountain! This new project involves reservoirs at two successive levels, the lower dam forming a tailrace pool at the upper dam for two A-C reversible pump-turbines, each rated 87,000 hp at 180-ft head. Conventional hydro-generating units will also be installed — two higher-head units at the upper dam and two lower-head units at the lower dam.

For complete information on pumped-storage, hydro-generating equipment or other components for water control, contact your nearby A-C office. Or write to **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1385

Effects of Lightning on Penelec's EHV Line Studied



Studies of lightning phenomena and their effects on extra-high-voltage transmission lines will be made for the next several summers from a mobile laboratory (left) atop Dunning Mountain, Pa., a few feet away from Pennsylvania Electric Co's new 460-kv line. Oscillographs, cameras and other recording devices are connected to the line, located in an area with a relatively high isokeraunic level. Electrical storms occur 38 to 40 days each summer.

Penelec assigned Steve J. Polaski and General Electric Co named Donald J. Heller for the task. They will live in the trailer-lab. Both men spent six months of intensive preparatory work at GE, and this included a series of tests using 40,000 amp of man-made lightning to insure safe connections to the line.

Allis-Chalmers Installs Its First Regu/Tran Assembly

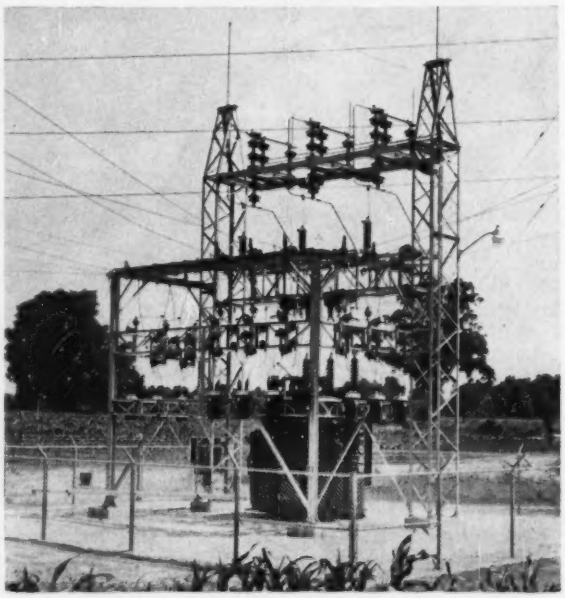
The first commercial installation of Allis-Chalmers Manufacturing Co's new REGU/TRAN assembly is this 3,750-kva substation installed for the Fruit Belt Electric Co-operative (Cassopolis, Mich.).

Units are available either fully assembled or as individual components for field assembly in hard-to-reach areas—where integral tap-changing equipment cannot be used, due to weight and size.

Each REGU/TRAN assembly consists of three single-phase regulators directly mounted on a 3-phase power transformer with a by-pass switch located above each regulator.

This simplified arrangement, points out A-C, provides single-phase regulation with a 3-phase unit assembly. One low-cost concrete pad is required for mounting the entire assembly and substation space needed is reduced.

By-pass switches, with a visible disconnect feature, permit regulators to be safety by-passed for periodic inspection without interrupting transformer continuity. Regulators are standard JFR units with self-contained control power, potential and current transformers. They are equipped with a Feather-Touch control.



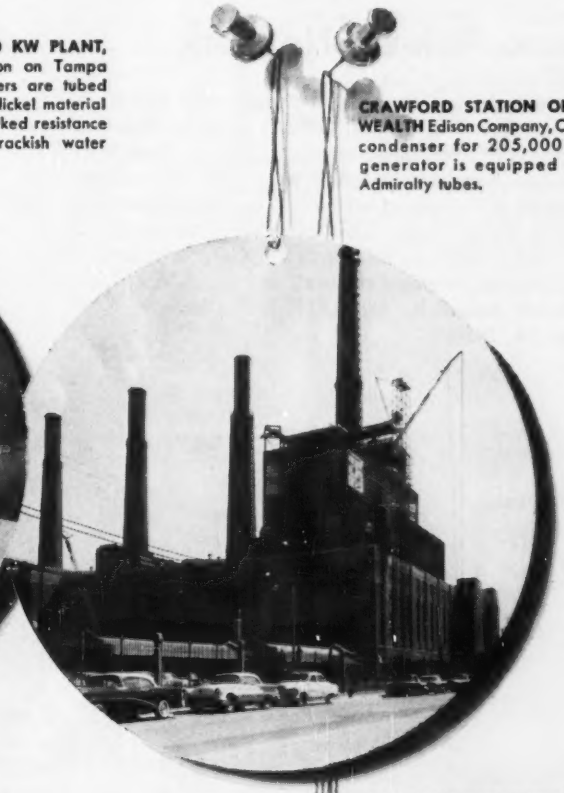
MANUFACTURERS BRIEFS

• **Square D Co** has expanded its product line by purchasing that portion of the business of Gateway Erectors, Inc, devoted to underfloor steel duct products. Shortly, Square D also will buy a plant in the south for production purposes.

• **Kaufman Enterprises, Inc,** has been established in Kaufman, Texas, to design and fabricate electric transmission towers, switchyard structures and aluminum substations. The firm also makes all types of steel and aluminum structural components.

TUBED BY REVERE MEANS TUBED TO LAST

A. W. HIGGINS 135,000 KW PLANT, Florida Power Corporation on Tampa Bay. Here all 3 condensers are tubed with Revere 10% Cupro-Nickel material because of this alloy's marked resistance to corrosion from the brackish water encountered.



CRAWFORD STATION OF COMMONWEALTH Edison Company, Chicago, where condenser for 205,000 kw. turbine generator is equipped with Revere Admiralty tubes.

A few more power companies who depend on REVERE Tubes for performance plus service

Revere's Technical Advisory Service, because of its long and varied experience, is qualified to help in the selection of the alloy best suited to the specific set of operating conditions encountered in *your* power plant. This experience, which has covered many and varied types of problems, has been instrumental in prolonging tube life for power plants both large and small.

Why not take advantage of this storehouse of knowledge and contact Revere before making the final selection of tubes and plates for your equipment?

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Sales Offices in Principal Cities. Mills: Rome, N. Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford and Plymouth, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb.

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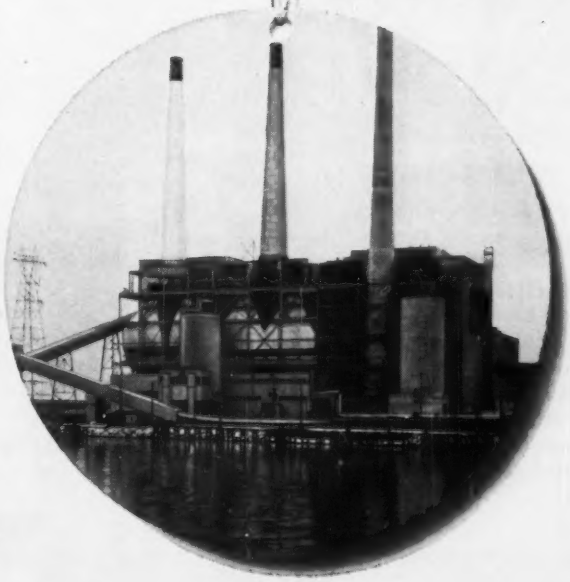
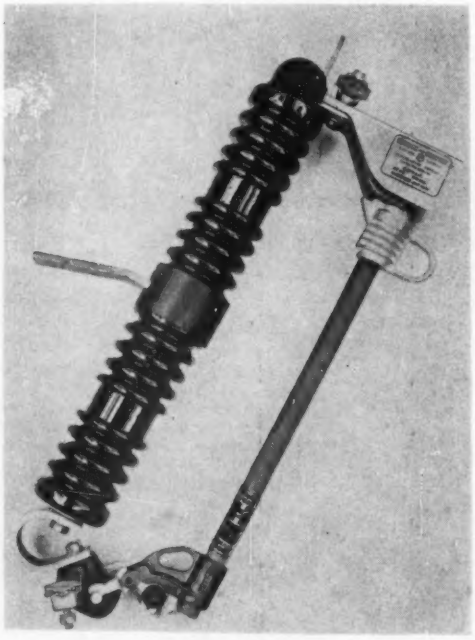


ALLIS-CHALMERS CONDENSER serving the new 265,000 kw. turbine generator Unit #2 River Rouge Station, Detroit Edison Company contains 249,000 lbs. of Revere Admiralty condenser tubes. Tube sheets are Revere Muntz Metal. A lasting combination!

New Equipment

Corona Pick-Up Network . . .

. . . extracts corona signal from circuits with potentials up to 100 kv. The Model 8562M1 Corona Pick-Up, built around a corona-free high voltage capacitor-divider circuit and associated filters, has its high voltage connection at the top of an insulator cylinder measuring about 18 in. high. This cylinder is mounted on a base which contains the terminals for connection to an oscilloscope or other corona detection device.
Associated Research, Inc, 3777 W Belmont Ave, Chicago 18, Ill.



Drop-Out Cutouts . . .

. . . for 27 kv features single-vent, small-bore design. No. 2580 has an interrupting capacity of 3,000 amp, No. 2581 an interrupting capacity of 6,000 amp—both cutouts have a continuous current rating of 100 amp. While positive operation is assured for all fault currents within range of the cutout, safety is assured because the single confined cone of gases is directed downward and away from personnel and equipment.
Hubbard & Co, 200 S Michigan Ave, Chicago 4, Ill.

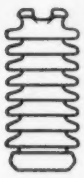
Maintenance Platform . . .

. . . fits on pick-up truck. Unit, weighing 200 lb, adapts readily to bed of truck, extends upward for reaching work up to 32 ft, telescopes and folds down with work platform over cab. It can be quickly removed from truck bed for use inside buildings.
Up-Right Scaffolds, 1013 Pardee St, Berkeley, Cal.

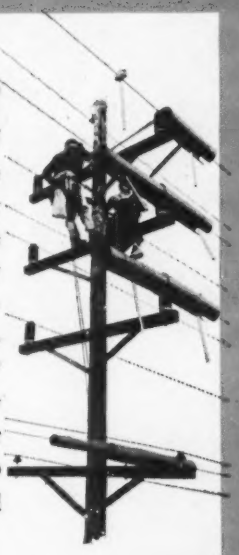
4 ways

to build economy ... and better performance ... in sub-transmission construction

TIE-HEAD LINE POST

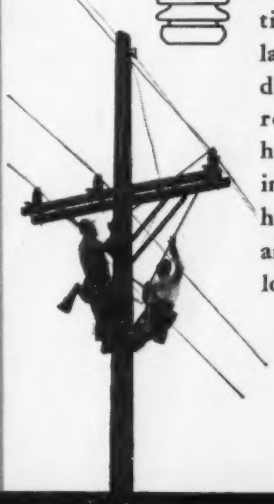


Up-to-date version of Lapp's original Line Post—the insulator with a 29-year service record of high-security operation. Inexpensive tie-wire installation provides a "mechanical fuse" when conductor breaks. New wide-throat conductor grooves on all units rated to 88 kv. The industry standard for most applications.

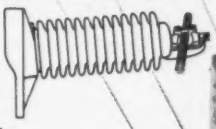


CLAMP-TOP LINE POST

Clamp attachment particularly adapted to large aluminum conductors with armor rods. Best for use in hilly terrain. Simplest installation, easiest for hot-line maintenance, and eliminates tie-wire loosening.



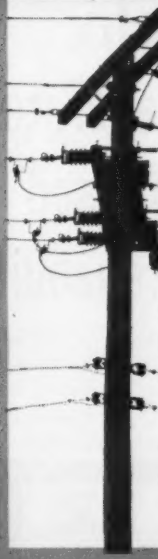
HORIZONTALLY-MOUNTED LINE POST



Save up to one-third in materials—more in labor of erection—with armless construction using Lapp Line Post with integral base-and-gain. Permits longer spans, larger conductors, greater safety margins. Eliminates contamination flashover, pole-top burning.

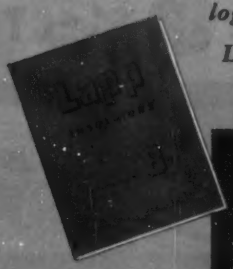
LINE POST FOR SLACK-SPAN DEAD-ENDS

Strain clamps supported by horizontally-mounted clamp-top Line Posts provide convenient, good-looking, radio-free slack-span support at sub-stations and line taps.

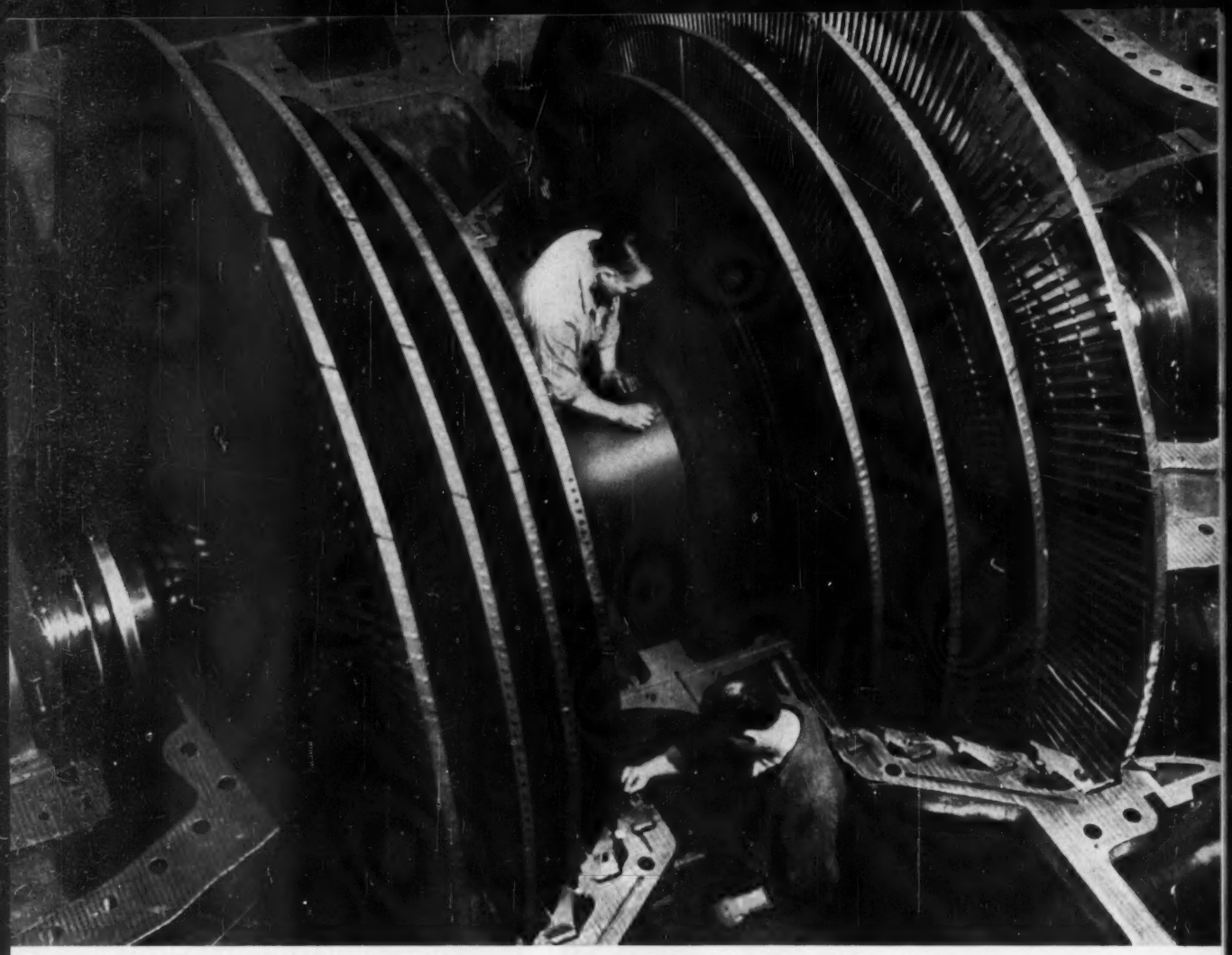


You'll find helpful data on use of a great variety of Lapp Line Post and Station Post Insulators in the new Lapp Catalog No. 8. Write for your copy.

Lapp Insulator Co., Inc.
LeRoy, New York.



Lapp



Precision workmanship by skilled craftsmen contributes to the efficiency and reliability of this 90-ton, 1800-rpm, low-pressure steam turbine rotor.

General Electric steam turbine-generators give you increased efficiency and reliability

Three areas where General Electric is continually making progress in improving steam turbine-generator reliability and efficiency are:

Pre-engineered designs—engineered simplicity is the key in these advanced turbine designs, ready now to meet your power generation needs.

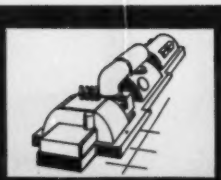
Nationwide service program—General Electric's service organization extends right to your neighborhood to give you personalized service by experienced representatives familiar with your particular machines and their place on your system.

Manufacturing breakthrough—with specialized automated machine tools and manufacturing techniques General Electric produces precision components that were unheard of a few years ago. 244-01

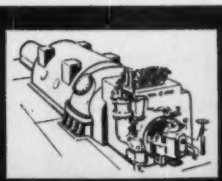
Progress Is Our Most Important Product

GENERAL ELECTRIC

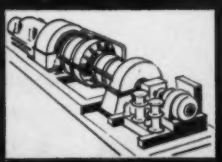
General Electric Turbine-Generators Help Keep Power Costs Low



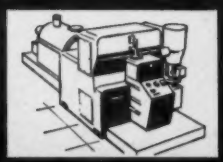
Steam turbine-generators for large blocks of power



Steam turbine-generators 100,000 kw and lower



Gas turbines for peaking, base load, combined cycles

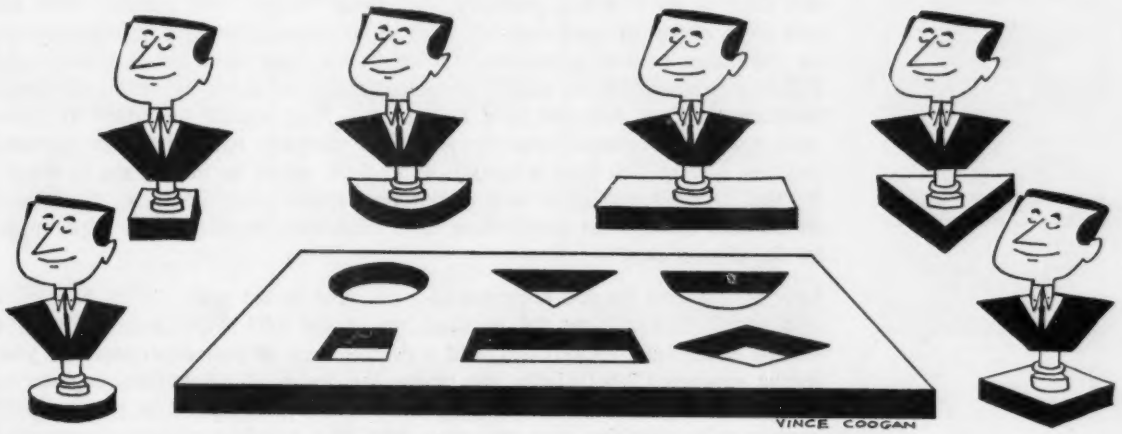


Mechanical drive steam turbines for auxiliaries

Electrical World

JANUARY 2, 1961

Management Newsletter



Make the Most of Your Manpower

LAST IN A SERIES OF THREE ARTICLES

Putting pegs into holes is a child's game. But the business executive plays it too; only for bigger stakes. He's trying to fill the many jobs in his organization with people, and the success of the company is the prize.

Business organizations are made up of people who perform numerous jobs. Some men will be locked in the immaculate confines of a laboratory working on the ideas that will form tomorrow's products or services. Others will be balancing the debits against the credits or stringing new service lines to new houses. The number of jobs within a company are many. And each job makes different demands upon the person who fills it.

It's important that the people selected be able to meet the requirements; that the talents they possess be suited to the demands that the job will make. This means that an important function of management is filling the right job with the right people. Or, to put it another way, management must get the round pegs into the round holes.

There are as many systems for filling positions as there are executives. But not all of them are advisable. One manager boasted, "It only takes me a minute to size up a man. I can talk with him for just a few seconds and I know if he's the man for the job." Other executives go to the opposite extreme. They will submit candidates to an endless barrage of psychological tests to "see if he's our type." It may take many painful weeks to formulate the decision. Probably the best way is found somewhere in between. Let's take a look at the method recommended by Commonwealth Services Inc consultants.

The first rule is to know the job you are trying to fill. And this means sitting down and spelling out the job requirements in detail. Not only do different jobs make varying demands upon the people who fill them, but also, the same jobs with the same title in two different companies are apt to be worlds apart. Suppose,

for instance, that two utilities are trying to fill a district manager position. Will the same man do for either job? Probably not, because the requirements made by the two jobs may be very different. One company may give almost limitless power to the district manager. He may handle all the affairs of the firm in his district, and may report only the most critical matters to the head office. Another company may be strongly centralized with the districts operated directly from the central location. In this case, the district manager may be concerned primarily with maintaining the corporate image in the area.

The requirements of these two jobs are totally different. It does no good at all to say, "We need someone to handle our affairs in the Southern district." What you need to know is just precisely what these "affairs" will involve. Will the man be in charge of maintenance? Will he be responsible for new construction; for the design of new substations? Must he hire and train his own assistants? Will he be responsible for sales? It's important to set down in writing the exact functions that the man will have to manage. It is equally important to know what tasks are excluded from the job. If a company handled all its planning and new construction from a central office, there would be little sense in requiring that district managers have engineering experience. Similarly, if all sales are handled through the main office, sales experience wouldn't be a requirement for the district chief.

After formulating the job requirements, you turn to the man. What kind of a man will it take to meet the requirements of the job? First, you will want a specific educational background, and a definite area of past experience. If your district manager's job includes supervising the design of substations, engineering background might become one of your man requirements. But if he serves mostly in community relations, then perhaps a man with a public relations background would be more preferable.

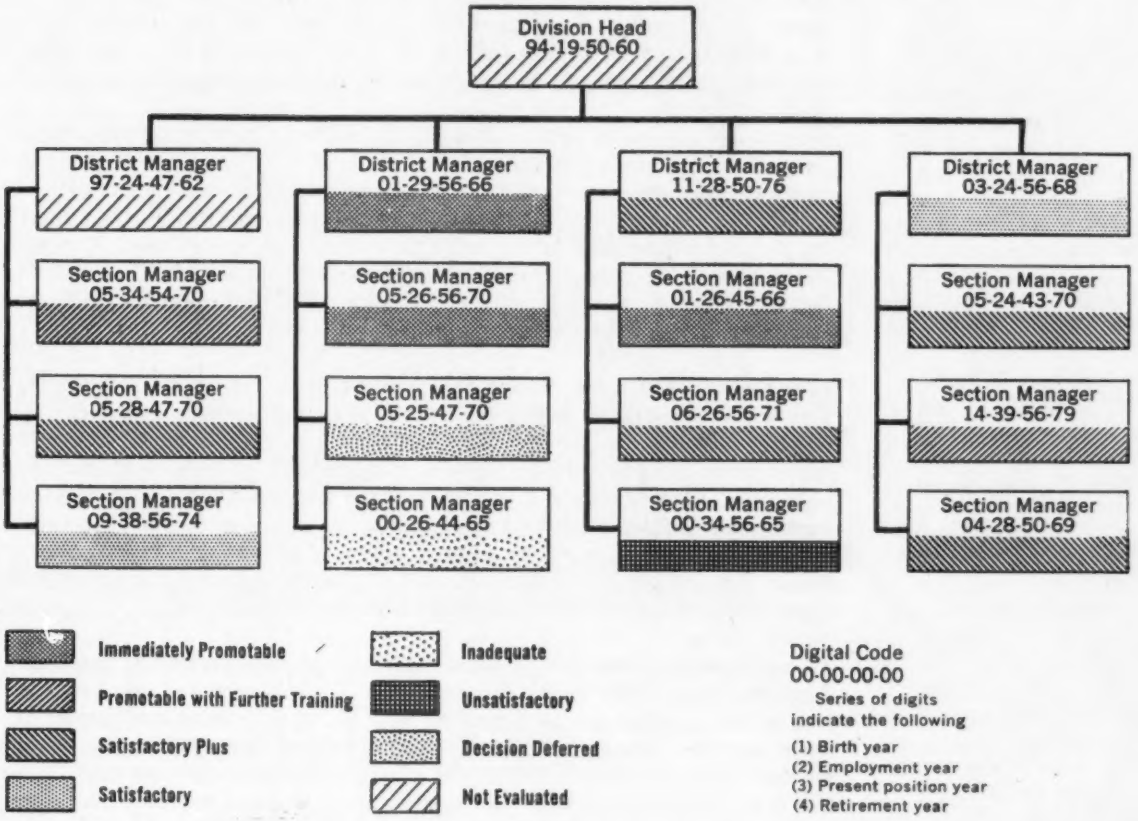
Aside from education and experience, there are several other criteria. Certainly, for most jobs, good health is a prerequisite. Conceivably, even temperament could be important. A job that applies constant pressure to the individual would hardly be the place for a man with two nervous breakdowns behind him. If the person you choose will be supervising or coordinating the activities of the district, division, or section, you will need someone with managerial ability. Here, the job will call for experience in handling people, in setting standards, in appraising performance, in the countless activities that are the task of the manager.

Since requirements vary from job to job, the man requirements will vary also. While this may seem obvious, the peculiar demands made by each job are frequently overlooked. Some companies feel that there is a "company type" who is suited to all jobs within the firm. They painstakingly prune the field of job applicants in search of this ideal creature, and are cautious to eliminate anyone who varies ever so slightly from the mold. This approach might be valid if all jobs in the company made essentially the same demands on the individuals who perform them. But this is true of a limited number of operations at best. In the majority of companies, many different activities are in process. And the requirements for jobs in research and development are quite different from those in public relations and sales. Consultants at Commonwealth Services Inc feel that it is essential for the executive to formulate a definite list of man requirements before he begins looking for the man. Otherwise it becomes a search for a vaguely defined person to fit a vaguely defined job, with little chance of real success.

After formulating your man requirements, you can put the job requirements into the desk drawer. That's because the man requirements should give you a fairly detailed description of the person you are looking for. But the problem is only getting started. The big question still remains. Where do you find the man?

The first place you should turn is to your own department. People who have some managerial experience within the department know the system. They are well aware of its strong points, and equally versed in its short-comings. At

Organization Development Chart



least in theory, they should be able to make the transition to the new job more easily than someone strange to the workings of the group. Of course, there's a bonus benefit to promoting from within. Other men in the department have a pointed illustration that good performance is rewarded. They will work all the harder in order to be ready by the time the next position opens. And finally, if a manager has been looking ahead, then promoting from within his own organization is a simple process. That's because he has projected his personnel requirements for several years into the future. When an important job opens, the man to fill it is waiting in the wings.

One way of projecting personnel requirements is with an organization development chart (above). This chart shows the organization graphically, supplying pertinent data on each individual, plus some indication of his promotability. This type of projection depends heavily on a program of periodic review of each man's performance. When such a review keeps the projection up-to-date, then the task of filling an opening becomes better organized. Potential replacements can be spotted long in advance and developed for promotion.

But even with such a projection, problems can arise. First, the chart doesn't create men; it merely follows their progress. It's quite possible that when a job opens, the executive may look at the organization development chart, and find that there is no one yet ready to assume the position. Or, perhaps the man next in line is unable, or unwilling to assume the new responsibility. Many a department has lost a promising replacement due to accident or poor health. In such a situation, even managers who have planned ahead find themselves suddenly with a job to fill. They have to begin a "manhunt" outside their department. But where do you get the facts on outsiders?

The Personnel Department of your company should be able to supply the answers. Naturally, they can't make the decision for you. This is a management responsibility that shouldn't be delegated. But if Personnel has been doing its job, it is in a position to supply you with all the raw material you will need for your decision. When personnel records are up-to-date, they should contain a wealth of data. First of all, they will list the educational background of each man, giving not only his degrees or certificates of completion, but also his areas of particular interest. Then, they will list the jobs he has held in the past, both outside and within the company, and any special training he has taken which is related to the activities of the company. Most important, the personnel record should contain the periodic reviews made of the man's performance by his superiors. Commonwealth Services' consultants feel that these reviews are perhaps the best indicator that the executive can use in making his choice. And they offer a suggestion on how to make the reviews even more helpful.

In any appraisal of a man written by a superior, there can be two shortcomings. The first shortcoming is due to personality differences between superiors. One manager may make all his appraisals favorable, varying only in the case of an exceptionally deficient person. Another manager may be quite conservative in his praise, using superlatives only to describe the outstanding. So, two men working for different managers may perform in the same fashion, but receive different evaluations due to the manager's way of expressing himself. Another danger is that simple personality conflicts may mar the objectiveness of such appraisals. It's easier to write nice things about someone you like.

To escape these pitfalls, Commonwealth advises that these reviews be made on a committee basis. This means that several of a man's superiors, his immediate boss as well as other managers familiar with his work performance prepare the report together. In this type of session, supervisors are compelled to cite reasons for their opinions. Reports coming out of such committees are more likely to be free from personal prejudices. But suppose the man requirements include some qualities that simply cannot be a matter of record?

Psychological testing is gaining importance in the business world as an accurate method of measuring these "intangible" qualities. The man's aptitude for the work, his motivations, his ambitions, and many other dark areas in his make-up are being illuminated to a great extent by such tests. But there's a danger.

Testing can be over-emphasized. In fact, some companies let the tests make the decisions for them. When a position opens, they go through the process of interviewing, studying records, consulting and testing. But when it comes time to make the decision, they forget everything but the test. That's because the test's result is tangible; it may even be written as a number. The manager overlooks the fact that the test score is only an indicator. It is not intended to be taken as absolute fact. And so a two-point difference in the scores is made reason enough for picking one candidate over another.

If a manager ignores a man's record with the company on the basis of a two-point test differential, he is not only doing the individual an injustice, but is also short-changing the company of one of its most vital assets, skilled personnel. It is by using the records, supplemented with test results, that managers have the best opportunity of locating the man they are looking for.

Skilled people are at a premium. A company that has enough talent to fill all its positions with quality is a rarity. With this situation it just doesn't make sense for an executive to staff his department in a haphazard fashion. To do so is simply to waste human talent, and to undermine the efficiency of the business. Sound organization, and good management techniques are a great help. But the common denominator of a rising enterprise is efficient, skilled people. And these people can help the most when they're in the right job.

MAIN OFFICE window display at KG&E served as focal point of the promotion. Contestants were asked to guess how high water would rise in one week

Promotion Helps Muzzle Moisture Monster

Dealers in the Kansas Gas & Electric Co territory recently received a booklet with an ominous looking character on the cover and the words, "Muzzle The Moisture Monster."

Dealers and distributors took up the battle cry and to the tune of 772 units showed housewives how the electric dehumidifier can muzzle moisture by preventing rust, mildew, mold, corrosion and rot.

Dehumidifiers, the public was told, remove up to four gal of water per day from the air; reduce humidity; assist over-worked air conditioners; and turn unusable space (playrooms, workshops, utility or storerooms) into new living area by drying out damp, clammy basements.

Campaign details were easy to follow and required a minimum of work on the dealer's part.

Dealers signed a simple agreement form whereby they agreed to:

1. Display at least two dehumidifiers on the sales floor during the promotional activity.

2. Offer free home trials.

3. Have a suitable stock of dehumidifiers for sale.

4. Run a minimum of 30 in. of newspaper advertising, or comparable radio or TV time.

KG&E in return did its part.

All participating dealers were mentioned, along with brand names, in new space advertising.

Also, a special deal was an offer to do all the delivery work.

If the dealer so desired, the utility arranged to have the unit delivered at no cost to the dealer.

For sales to customers within a radius of five miles, a package delivery service picked up the unit and delivered it. The dealer receipt and invoice for the delivery charge were returned to the utility.

At divisions outside Wichita, KG&E personnel picked up and delivered the units.

KG&E then turned things over to the dealers.

The utility provided floor and window banners to dealers.

Any prospects turned up by utility employees were turned over to participating dealers.

If the dealer wanted to he could make his own delivery in order to instruct the customer and sell the dehumidifier features.

A dehumidifier dealer display contest was the key part of the campaign.

Dealers were supplied with several "tried and tested" display ideas.

After the display was set up the dealer had a picture taken of the display by a KG&E sales representative.

Entries were judged by utility executives from the photographs.

Winning dealer received a free weekend at an Oklahoma lodge for himself and his wife.

A display in the front window of the KG&E main offices served as a focal point of the promotion (see photo). The man in the tank (actually a photo) was a local disk jockey. An operating dehumidifier was installed outside the window (it's not visible in the photo but is in the upper right hand corner) which fed the condensate through a tube into the window and then into the tank.

The gimmick was to guess how high the water would rise in the tank during a one-week period.

The contest ran for three one-week periods and was supported with saturated spots on radio, both utility commercials and with the station using the contest as an institutional promotion.

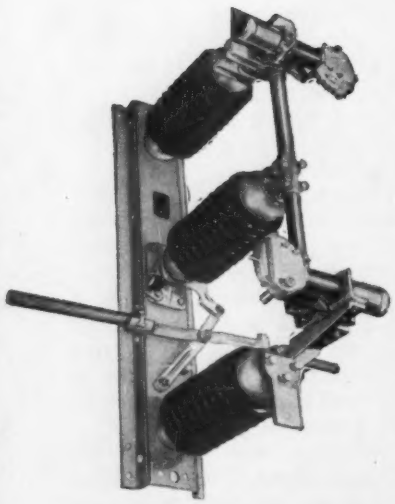
Interest?

Wilson K. Cadman, KG&E residential-rural sales manager, said, "Our area is usually blessed with low humidity and, as a consequence, dehumidifiers have never been a sales factor. With this in mind, we think the results are encouraging and it should prompt dealers to show more interest in the appliance in the future."

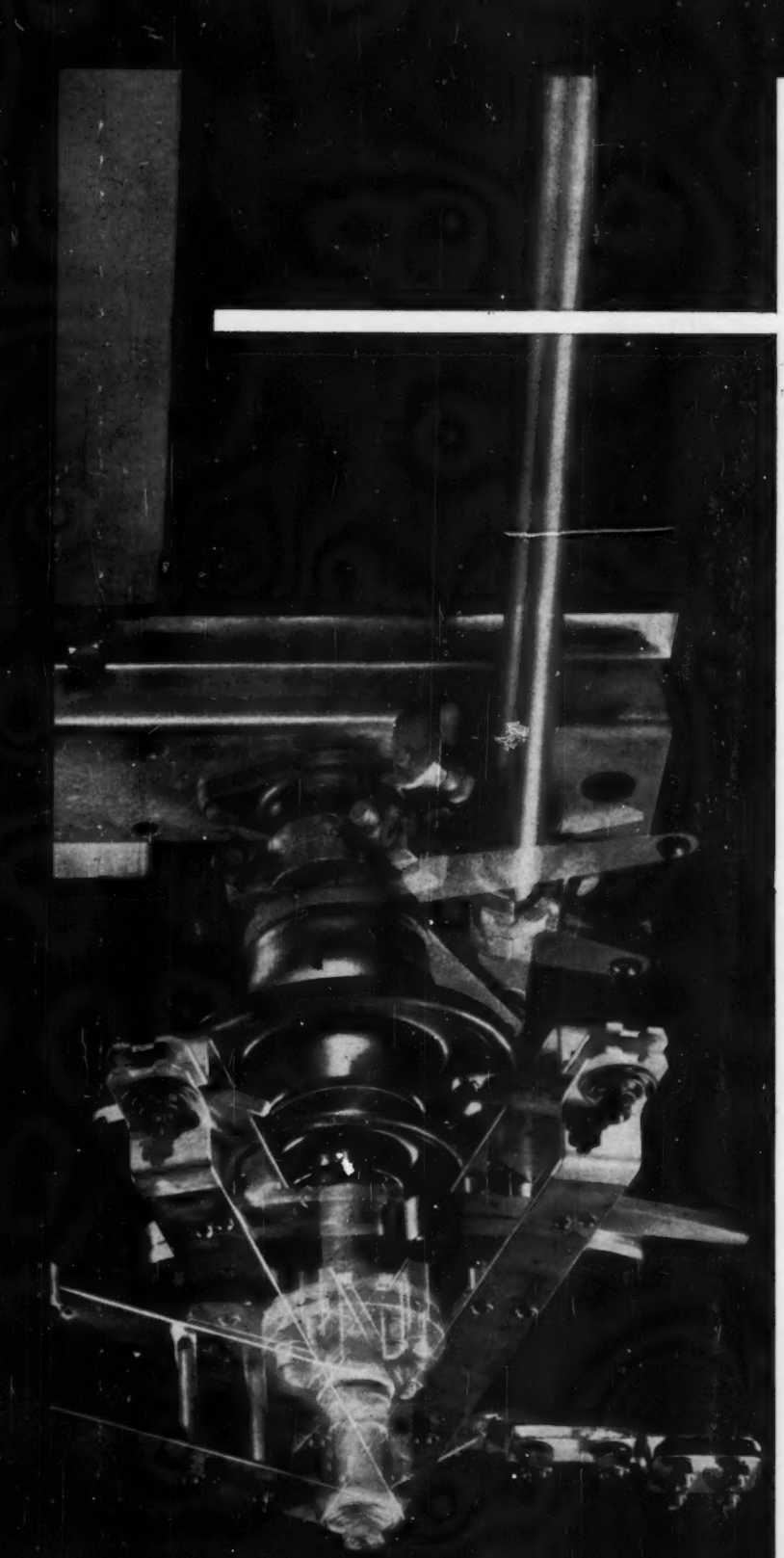
One dealer who sold over 60 units marketed them at full mark-up, no trade-ins, no installations, and called it "the cleanest business he had ever done."

SPLIT THE LOAD

(OR EVEN DUMP IT)



Double-Break Style 34.5 kv rating (above) and Side-Break Style, 14.4 kv rating (right)



with S&C Load Interrupters that cost no more than disconnects

Now from S&C you can get load interrupters at the same price as disconnects. This means that you can handle any kind of line switching in the simplest way at the lowest possible cost.

Here are the devices that do it:

1. The Side-Break Alduti Load Interrupter at 7.2 kv and 14.4 kv, and
2. The Double-Break Alduti Load Interrupter at 23 kv and 34.5 kv.

Both give you load dumping* (full 600-ampere arc-free load switching at full line voltage) along with loop sectionalizing (switching currents in parallel or loop circuits) and line dropping (switching line charging currents).

Since these switching duties at today's voltages and loads can't be handled by disconnects, why not compare the cost of S&C Load Interrupters with disconnects. You'll find there's no premium price for premium performance.

Here are some of the other advantages of S&C Load Interrupters:

- 600-amp load switching without line or feeder breaker openings
- a maintenance-free interrupting device
- no external arc
- can be mounted in any position . . . vertical, upright or inverted.

For more information, please contact S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Ill.

* Important because: (1) Emergency situations (wires down, etc.) demand quick action, hence dumping the load. There is no time to set up communications for complicated breaker and switch sequencing. And (2) there's always the possibility of an operator error or misunderstanding, with the result that a loaded circuit may be dumped inadvertently.

S&C ELECTRIC COMPANY

S&C

Urge Protecting Free Enterprise (*Continued from page* 29)

already notified the AEC of its readiness to negotiate an agreement.

Regulation Progress—Uniformity in treatment by various commissions of liberalized depreciation in rate making has not been achieved. In most rate cases during the year, commissions recognized as a current expense a provision for deferred income taxes where utilities used liberalized depreciation, rather than straight-line depreciation.

Engineering—The cost-of-service subcommittee suggested developing percentages or weighting to be applied to residential, commercial, and industrial consumers' groupings in calculating cost of service statistics. No action has been taken. The electric meter testing subcommittee will review every sample testing plan of utilities and try to develop standards. The service rules subcommittee prepared suggested regulations governing service supplied by electric companies and has sent them to the Edison Electric Institute for comment. The committee said that the EEI "will have a number of comments on the suggested rules, which have not yet been sent to the subcommittee." The code for electric meters of the American Standards Assn is now undergoing revision.

Depreciation — Maximum levels at which depreciation reserves become stabilized depend on mortality characteristics of plant and the average rate at which the plant is growing. Under the conditions specified in the report, stabilization levels range from 18.3 to 42.4%.

Valuation—There will be many new products and services, hitherto unheard of, and many of which will overlap and compete in the areas traditionally served by utilities. Prices will probably continue to rise under the impetus of demands for higher wages and high rates of taxation.

Procurement and Training—This report urged a new canvass of state and federal commissions on their desire to participate in development of the short training course for regulatory commission personnel. It noted that many business and industries, competing with commissions for young professional graduates, offer such courses and even longer ones. The report stressed the course as an incentive in recruiting engineering personnel, and the committee said that it was seeking the reasons for non-participation by some commissions.

The report also referred to the use a brochure, prepared by the committee last year, in recruiting technical personnel and noted that this brochure was still available.

The following resolutions, asking Congress to sponsor legislation affecting electric utilities, were passed:

- To ban automatic rate increases now authorized to gas pipeline companies by federal statutes.
- To limit General Services Administration participation in rate proceedings and to bring to the attention of the commission any peculiar needs of any federal agency represented by GSA.
- To coordinate the equality and treatment among all generation facilities, both federal and non-federal, to obtain downstream and upstream benefits.

The vote on banning automatic rate hikes for gas pipeline companies followed a spirited floor battle and was 29 to 16, 15 member commissions abstaining.

The proposed legislation was submitted by a subcommittee assigned to study the effect of natural gas rates on the ultimate consumer. Subcommittee Chairman Everett C. McKeage, California commission president, submitted the proposed legislation.

McKeage said the proposed resolution is aimed at invalidating indefinite pricing clauses in the natural gas contracts. The Federal Power Commission had sought this legislative remedy for years.

McKeage pointed out that, under present law, a gas pipeline company can increase rates repeatedly, without new authorization from FPC. He said that there have been instances of as many as 20 rate increases put into effect without FPC authorization.

"The proposed amendment," he said, "would permit only one such rate increase as applied to a particular customer. All other such rate increases by operation of law could be barred until the FPC had passed upon the reasonableness of one increase. This amendment would not prohibit the FPC from placing into effect a filed rate increase, even without passing upon the reasonableness of such an increase. The amendment would not restrict the automatic operation of the statute."

Principal opposition to the proposed legislation was based on the contention such legislation would be unconstitutional and premature. Commissioner W. J. Murray Jr, of the Texas Railroad Commission and a member of the subcommittee, stressed this opposition. Murray said that "any action should be delayed until the study has been completed and the association given an opportunity to study all phases."

The executive committee of the NARUC announced that the 73rd annual convention of the association will be at Atlantic City, N. J.

The association elected the following officers: president, Peter E. Mitchell; first vice president, and chairman of the executive committee, David M. Brackman; second vice president, Joseph J. Brown, Nebraska commission.

P. E. MITCHELL, president, (center) congratulates J. J. Brown (l to r), D. M. Brackman, A. L. Roberts Jr, and E. Kreeger, fellow NARUC officers elected for 1961

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"By reason of special training, wide experience and tested ability, coupled with professional integrity the consulting engineer brings to his client detached engineering and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."

Hayward Named Atlantic City Electric Head

JAMES P. HAYWARD

Atlantic City Electric Co has elected James P. Hayward president, succeeding Charles M. Hagan who resigned because of ill health.

Hayward joined ACE 35 years ago as a draftsman. He has held many posts with the utility, including distribution engineer and superintendent of transmission and distribution. Hayward became vice president of electric operations in 1957 and two years later was elected executive vice president.

President of the New Jersey Utilities Assn, Hayward is also a member of the New Jersey Professional Engineers Society.

WYLIE LANPHIER CLARK BLANCHARD

Sangamo Appoints Wylie VP, Three Senior Vice Presidents

Robert R. Wylie has become vice president of Sangamo Electric Co. R. C. Lanphier Jr, C. L. Clark, and D. C. Blanchard were named to the newly-created posts of senior vice presidents.

Wylie has been in the utility industry for more than 20 years. He joined Sangamo as marketing manager in 1957, after serving as manager of meter and capacitor sales for the Rumsey Electric Co from 1941. His present assignment is vice president-manager of electronic product sales.

Lanphier has been vice president-director of sales since 1939. Clark has been vice president and treasurer since 1953, and Blanchard vice president in charge of manufacturing since 1954.

Weaver Elected President of Atomic Industrial Forum

Charles H. Weaver, vice president in charge of atomic power activities for Westinghouse Electric Corp, has been elected president of the Atomic Industrial Forum, Inc.

Elected vice presidents were: James F. Fairman, senior vice president of Consolidated Edison Co of New York; Roy M. Casper, vice president of Allis-Chalmers Manufacturing Co; and Philip Sporn, president of American Electric Power Service Corp.

Weaver has been a director of the Forum since 1955 and chairman of its budget and finance committee for the past two years. He joined Westinghouse in 1936, became atomic power division manager in 1948, and a Westinghouse vice president in 1955.

PERSONAL BRIEFS

Tacoma Department of Public Utilities has named **Francis E. Ash** head of the administrative division.

Merrill DeMerit, chief power engineer for Tennessee Valley Authority, has retired.

Dudley Sanford has resigned as executive vice president of Union Electric Co. He will continue to serve on the board of directors.

William E. Newberry has succeeded **William H. Kubler** as Georgia Power Co's Macon division industrial sales engineer. Kubler became assistant manager of the industrial sales engineering division. **Howard J. Wilson** became assistant to the Atlanta division vice president. **John J. McDonough,** company president, was named Georgia Engineer of the Year by the Georgia Society of Professional Engineers.

S. F. Diffenderfer has succeeded **H. H. Brenan** as manager of Pennsylvania Power & Light Co's business development department. Brenan retired.

Donald J. Gray has joined Mississippi Power & Light Co as a management consultant after resigning as vice president and general manager of Masonite Corp.

Public Service Co of Oklahoma has promoted **Johnie S. Holeman** to transmission maintenance engineer and **James E. England** to superintendent of distribution engineering.

Kansas City Power & Light Co has made these personnel changes: **Frank C. Payne** to staff assistant to the executive vice president; **Wayne R. Johnson** to manager of internal services; **E. B. McBurney** to superintendent of stores; **H. J. Dunshee Jr** to staff engineer in the transmission and distribution department; and **Forrest Roulund** to industrial engineer in the sales department.

Malloy J. McQueen, associate general counsel of the Department of Health, Education and Welfare, has succeeded **John C. Mason** as deputy general counsel of the Federal Power Commission. Mason became FPC general counsel.

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Electrical System Design Engineer. At least 3 years experience in transmission, distribution or substation design. Resident Engineer —experienced in construction of rural type transmission, distribution and substation facilities. These openings offer permanent employment with opportunity for advancement. P-5809, Electrical World.

Medina Electric Cooperative, Inc. is receiving applications for Senior Operators, Control Operators, and Plant Electricians for employment in a new 66,000 KW Steam-Electric Generating Plant 50 miles south of San Antonio, Texas. Send complete resume to Medina Electric Cooperative, Inc., Box 1028, Pearsall, Texas.

Utility Electrical Engineer—for administrative headquarters of nationwide utility; must have E.E. degree, preferably with an additional business or advanced engineering degree. A minimum of 8 years of engineering, operating and administrative experience is required. Age 30-45. Salary open. Send resume of background and qualifications to: D. Olshansky, Citizens Utilities Company, Ridgeway Center, Stamford, Connecticut.

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Representative wanted for manufacturer of street lighting equipment pole line specialties. Western States. Full particulars. RW-5056, Electrical World.

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Somewhere,

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QU.	KVA	MFG	VOLTAGE
1	12000	G. E.	115,000—46,000 L. T. C.
1	5000	West.	115,000—13,750, 3 Ph.
1	10000	West.	67,000—34,500, 3 Ph. Auto.
1	3750	G. E.	69,300—13,200, 3 Ph.
1	3000	G. E.	69,000—4340. 3 Ph.
4	2000	Amer.	67,650—22,000
6	1667	West.	66,000—2300/4000
3	1250	G. E.	69,300—2400/4160
4	333	West.	67,000—7200/12470MY
2	2500	Wagner	45,000—4160Y, 3 Ph.
3	333	G. E.	44,000—480
1	5000	West.	34,500—13750/6875, 3 Ph.
1	4500	West.	33,000—2500/4330, 3 Ph.
2	3000	Upgf.	34,750—4160, 3 Ph.
2	1500	G. E.	34,400—2520, 3 Ph.
3	1250	A. C.	33,000—480
3	500	Mol.	34,500—2300/4600
3	200	A. C.	34,500—2400/7200/12470Y
2	3000	G. E.	26,400—4160Y/2400, 3 Ph.
2	3000	G. E.	13,800—2640, 3 Ph.
1	2500	G. E.	13,800—2400, Unit Sub.
3	667	G. E.	13,200—240/480
1	600	Stand.	13,200—2300, 3 Ph.
3	500	G. E.	13,200—240 x 480
1	450	Penna.	13,200—2400, 3 Ph. Askarel
3	100	A. C.	6,900—2400
1	1000	A. C.	2,400/4,160—240, 3 Ph.
3	400	G. E.	2,300/4,000—230/460
3	333	West.	2,400—240/480

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1	4600 Kw, 60 cycle, 13800 volts, Generator 6500 Hp, 25 cycle, 11000 volts, Motor—300 Rpm
1	1500 Kw, 60 cycle, 2300 volts, Generator 2100 Hp, 25 cycle, 2300 volts, Motor—300 Rpm
2	1000 Kw, 60 cycle, 2300 volts, Generator 1580 Hp, 25 cycle, 2300 volts, Motor—300 Rpm

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3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
4—1000 KVA Mol 7200/12470Y—4160
3—1000 KVA G-E 34500-7200/12470Y
6— 500 KVA G-E 34500-2400/4160Y
3— 833 KVA W-H 43800—480
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA GE 66000—2400/4160Y
3— 333 KVA Wag. 2400—120/240
2—1500/1875 KVA Mol. 3-Ph. 40,500—4800 F/C equipped
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2—1500/1875 KVA Mol. 3-Ph. 43800—2400/4160 F/C equipped

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JANUARY

Symposium on Thermoelectric Energy Conversion — Statler-Hilton Hotel, Dallas, Jan. 8-12.

Pennsylvania Electric Association — Advertising Committee, Harrisburg, Jan. 9-10; Residential Committee, Mountain View Hotel, Greensburg, Jan. 16-17; Customer Contact Committee, Philadelphia, Jan. 18; Accident Prevention Committee, Holiday Motor Lodge, Harrisburg, Jan. 19-20; Street and Highway Lighting Committee, Harrisburg, Jan. 19-20; Personnel Practices Committee, Philadelphia, Jan. 26; Communications Committee, Pittsburgh, Jan. 26-27; Stores Committee, York, Jan. 26-27; Structures and Hydraulic Committee, Benjamin Franklin Hotel, Philadelphia, Jan. 26-27.

Reliability & Quality Control Conference—Sponsored by the AIEE-IRE-ASQC, Philadelphia, Jan. 9-11.

Edison Electric Institute—Home Service Committee, Chicago, Jan. 11; Live Better Electrically Women's Conference, Edgewater Beach Hotel, Chicago, Jan. 12-14; Residential Wiring Promotion Committee, Washington, D. C., Jan. 16-17; Electric Space Heating & Air Conditioning Committee, New Orleans, Jan. 23-24.

• **National Rural Electric Cooperative Association**—Workshop VI on "Managing The Member Education/Power Use Program," Seattle City Light Auditorium, Seattle, Jan. 12-13.

Instrument Society of America—Winter Instrument-Automation Conference & Exhibit, St. Louis, Jan. 17-19.

Canadian Electrical Association—Eastern Zone, Nova Scotian Hotel, Halifax, N. S., Canada, Jan. 23-26.

Plant Maintenance & Engineering Show—International Amphitheatre, Chicago, Jan. 23-26.

Southeastern Electric Exchange—Legal and Claims Committee, Miami Beach, Jan. 25-26.

American Institute of Electrical Engineers—Winter General Meeting, Hotel Statler, New York City, Jan. 29-Feb. 3.

American Society for Testing Materials — Committee Week, Netherland Hilton Hotel, Cincinnati, Jan. 30-Feb. 3.

FEBRUARY

Edison Electric Institute—Commercial Cooking & Water Heating Committee, Atlanta, Feb. 1-2; Taxation Accounting Committee, Deshler Hilton Hotel, Columbus, Feb. 8-10; National Conference of Electric & Gas Utility Accountants, Chase-Park-Plaza Hotels, St. Louis, Feb. 16-19.

• **Intermountain Electrical Association** — Annual Convention, Hotel Ben Lomond, Ogden, Utah, Feb. 2.

Pennsylvania Electric Association—Land and Land Rights Committee, Philadelphia, Feb. 2-3; Prime Movers Committee, Pittsburgh Hilton Hotel, Pittsburgh, Feb. 2-3; Transmission and Distribution Committee, Penn-Harris Hotel, Harrisburg, Feb. 8-9; Motor Transportation Committee, Harrisburg, Feb. 9-10; Systems Operation Committee, Harrisburger Hotel, Harrisburg, Feb. 9-10; Electrical Equipment Committee, Pick-Roosevelt Hotel, Pittsburgh, Feb. 16-17; System Planning Committee, Philadelphia, Feb. 20-21; Relay Committee, Pittsburgh Hilton Hotel, Pittsburgh, Feb. 23-24.

National Electrical Week—Feb. 5-11.

Electrical Manufacturers Exposition—Third Bi-Annual Meeting, Veteran's Memorial, Columbus, Feb. 7-9.

Missouri Valley Electric Association—Industrial and Commercial Sales Conference, President Hotel, Kansas City, Feb. 9-10.

• **National Rural Electric Cooperative Association**—Annual Convention, Dallas, Feb. 13-16.

• Additions this week.

Watt Transducer Operates on Hall Effect (*Continued from page* 47)

obtained for the transducer.

The transducer is temperature-compensated for an output circuit resistance of 50 ohms. In the case of the transducer with filter, this 50-ohm resistance is included in the form of a potentiometer inside the transducer itself. This type of transducer must operate into high-impedance loads—above 50,000 ohms —to insure half percent accuracy.

In the case of the transducer with unfiltered output, the 50-ohm impedance is external and is provided, for example, by the circuit of a permanent magnet moving-coil indicating instrument. This external resistance must be accurately maintained at the 50-ohm value to maintain proper temperature compensation and calibration.

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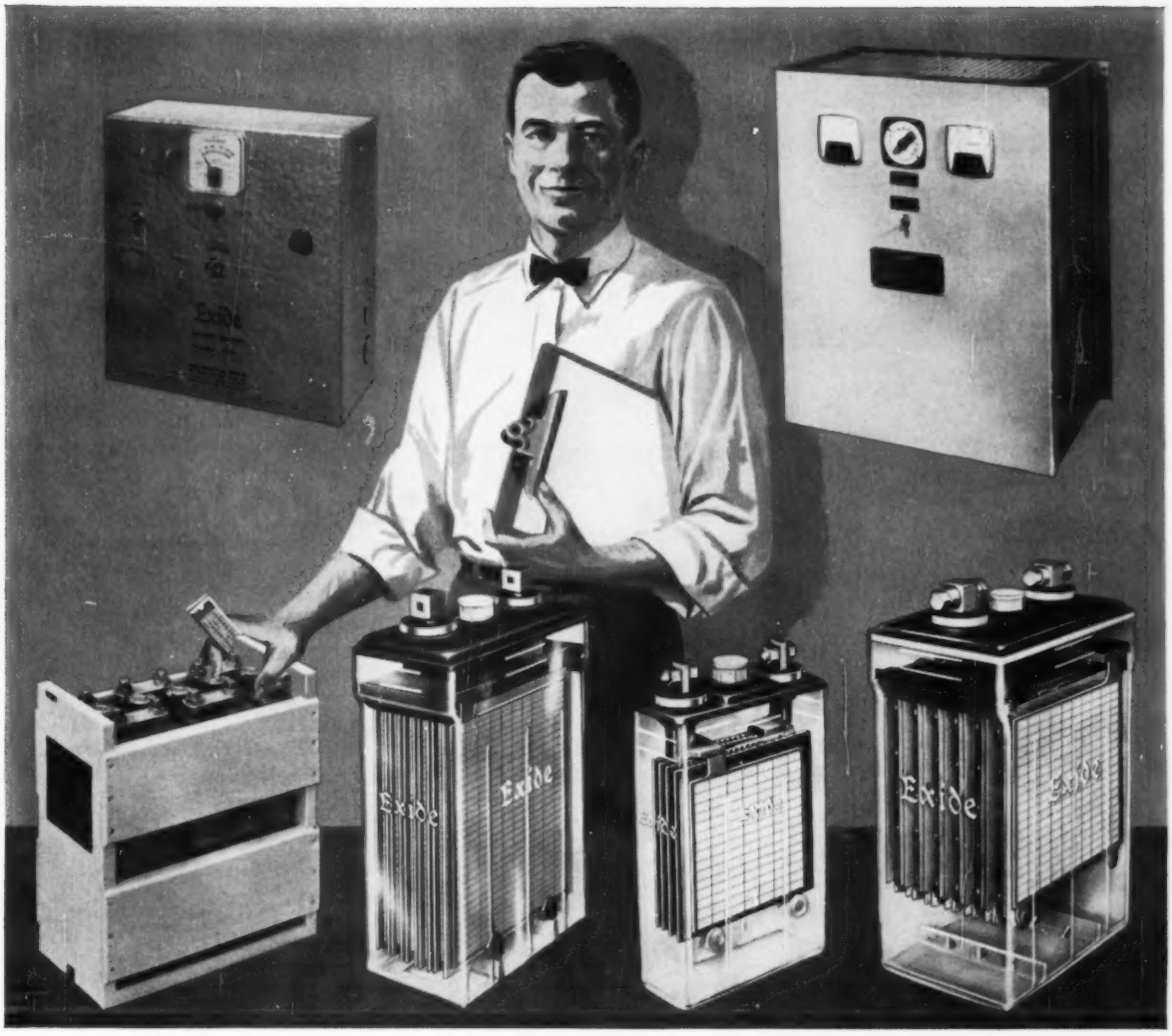


Exide determines the best battery type and charger for you by studying your particular duty requirements

Selecting a battery and charger today is really an engineering job. Each application has its own requirements. That's why Exide offers a variety of batteries and chargers—in fact the broadest in the field. It means you can buy the type battery and charger you should have. Because Exide has no ax to grind for any particular type, you can expect an unbiased recommendation.

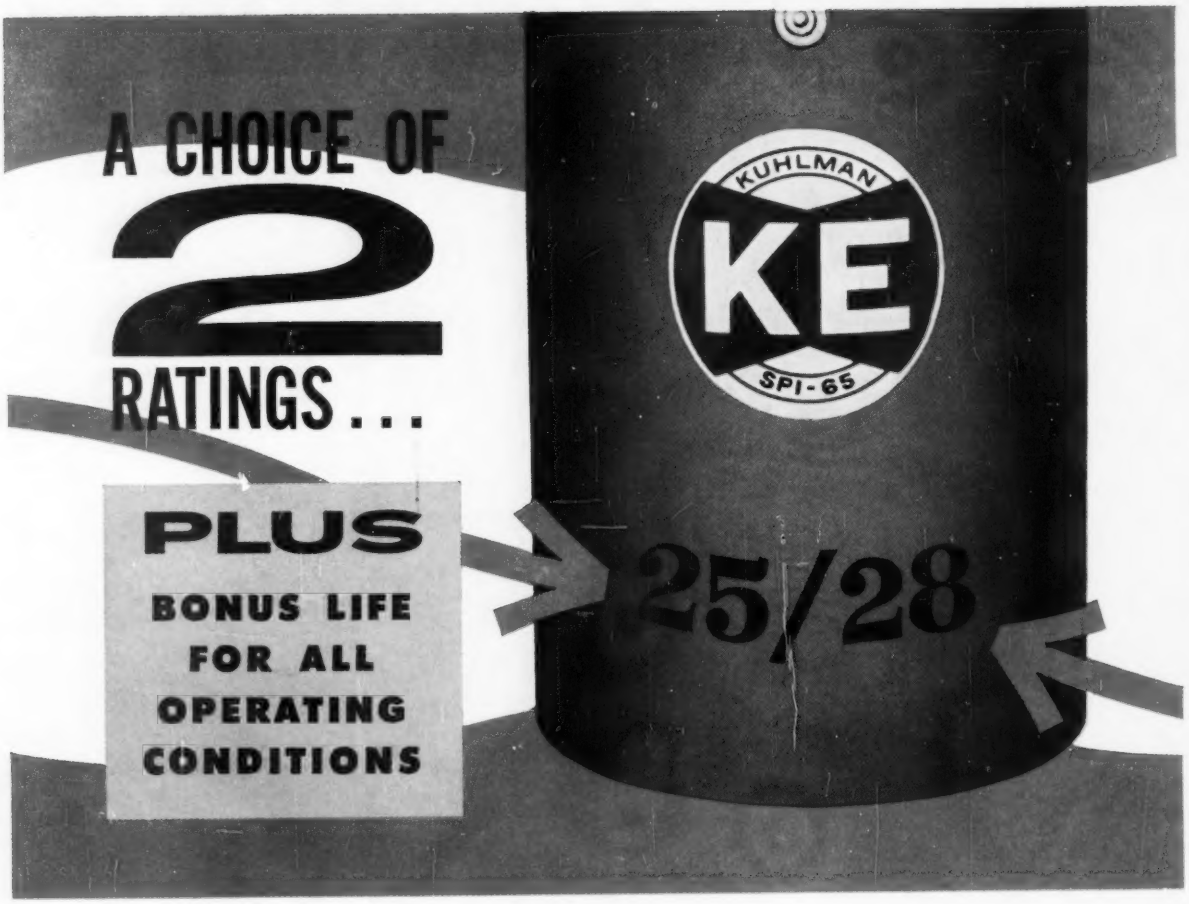
The battery line includes (1) flat plate Tytex with Silvium;* (2) flat plate Tytex with calcium; (3) long-life Exide-Manchex—Planté type—with Silvium; (4) low-maintenance pocket positive nickel-cadmium; (5) new 20-year Exide-Ironclad tubular with Silvium. The charger line includes (1) constant voltage type; (2) trickle or Hi-Lo type. You get Exide quality and value on all.

An Exide power package lets you buy with confidence. Exide service—the quickest, most dependable you can get—covers battery and charger. For complete information, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

*Silvium is Exide's patented corrosion-resistant grid alloy

Exide®

INDUSTRIAL MARKETING DIVISION (ESB)
The Electric Storage Battery Company



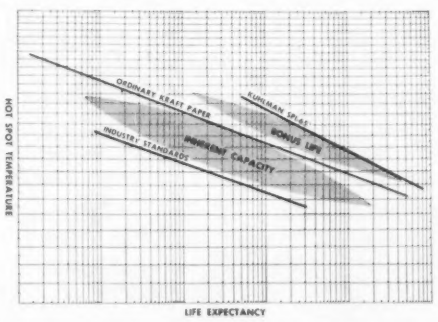
With Kuhlman you get a choice of two ratings (for example, 25KVA and 28KVA as shown above) and super insulation for longer than average operating life. Here are the facts.

First, thermal aging tests proved conclusively that Kuhlman uniform cooling and excellent thermal characteristics provide ample capacity for 12% more KVA per transformer within ASA-NEMA 65° maximum hot spot temperature.

Since extra capacity was inherent in Kuhlman design, it was a simple matter to uprate 12%. Tests also proved that SPI-65*—an improved, special treated insulation—was superior under all transformer thermal conditions to the standard kraft insulation used in most transformer design.

So don't sacrifice one for the other. Kuhlman gives you both—12% overload and longer than average operating life. Because Kuhlman offers capacity to spare, *plus* bonus life insulation. Don't settle for anything less. Order SPI-65* transformers direct from stock from your local Kuhlman representative and get bonus life for all operating conditions.

*Licensed under Westinghouse Insuldur® patent rights.



This life versus temperature test chart shows the inherent capacity and bonus life of Kuhlman transformers.

KUHLMAN TRANSFORMERS

Manufacturers of transformers since 1894

KUHLMAN ELECTRIC COMPANY, Birmingham, Michigan

FACTORIES: Bay City, Mich. • Crystal Springs, Miss. • Salinas, Calif.